AMERICAN ENGINEER CAR BUILDER AND RAILROAD JOURNAL.

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CONTENTS.

PROPOSED CONSOLIDATION OF THE MASTER CAR BUILDERS' AND MASTER MECHANICS' ASSOCIATIONS.

The suggestion of consolidation by concentrating the sessions of the conventions of the Master Car Builders and the Master Mechanics' Associations in such a way as to permit of holding them both in a single week was made in the address of President Soule to the Master Mechanics' Association last year, the support for this being the possible saving of time. The subject was brought to an advanced stage this year by President Leeds in his address before the same association, and he stated the arguments in favor of the actual consolidation of the associations so clearly that we quote from his remarks. Next to the question of representation this is the most important that has ever been brought up for discussion before the associations.

"The consideration of this matter has firmly established in my mind the opinion that if there ever existed a need for two associations that necessity has passed. The members of either being eligible for membership in the other, and their duties of research and advancement being not only identical but to a very great extent carried on by the members of both associations, the two associations should be consolidated for the mutual advantage of not only the members but of the railroads. Of the members of this association who do not appear in the M. C. B. membership, a very large majority are master mechanics who have an interest in and control car departments, as well as motive power, yet they are represented by one member for the whole railroad system by which they are employed. * * * If the two associations were combined, the work could be done with much less loss of time. For instance, two days are given to the opening. The election of officers and other incidental work consumes about all of two days. All this could and would be condensed into one day for each, and thus save two days; and if our work was largely done by committees, as in my opinion it should be, one week would suffice for the actual attendance. Besides this, in my opinion, a great deal better results could be obtained by one organization as strong as this would be than can possibly be by the two."

This recommendation by the President resulted in the appointment of a special committee to consider and report, to the Master Mechanics' Association, a plan for action, which was adopted unanimously. The part of the report which concerns consolidation was as follows:

"We believe the suggestions as to a consolidation of the two associations under one organization are wise and timely made, and should be carried into effect at the earliest practicable period.

"A large percentage of the car mileage representation in the Car Builders' Association is controlled by superintendents of motive power or master mechanics who are members of the Master Mechanics' Association, in which all master car builders are eligible to membership, and there would, therefore, seem to be no good reason why all business pertaining to construction and repairs of rolling stock, whether of engines or cars, should not be transacted in one association and at one convention. Fully one-half of the time of members from duty would be saved, and an equal amount of expenses to the railroad.

"The successful merging of the two associations would then render it quite possible under proper restrictions to carry out the suggestions of the President looking to the establishing of an interchange of motive power equipment in certain localities, as well as making it advisable to appoint a standing committee for conducting tests, and indicating to members the necessary requirements for interchange of motive power.

"Your committee recommend and believe that railroad managers will insist that supervision of rolling stock now exercised by the associations shall be placed under one organization.

"Your committee would, therefore, recommend that the Executive Committee of this association be intructed to at once confer with the Executive Committee of the Master Car Builders' Association and endeavor to arrange for a consolidation of the two associations under such name and conditions of membership as will do full justice to both * * * and the President of this association is authorized and directed to appoint a special committee, who shall also be members of the Master Car Builders' Association, to attend the next annual meeting of the Master Car Builders and present this subject for consideration."

It is perfectly natural that men who have had the interests of one or the other of these organizations close at heart for years should hesitate before taking, and also afterward should regret, action which would mean loss of identity, but when the best interests of the railroads are consulted, and this touches the foundations of both associations, the reasons for consolidation seem to outweigh those which may be raised against it. Whatever individual opinions may be, the union is probably only a question of time. It is interesting to note the observations of the railroad papers on this subject:

"Railroad Car Journal"—"This movement, which has long been in contemplation, now assumes tangible form."

"Railway Master Mechanic"—"It is evident that the consolidation of the two associations is near—probably not more than two years ahead. The tendency this way has been strong for years and lately it has grown in strength. Last year it almost took definite shape. This year President Leeds' outspoken address gave it a start from which there will be no receding. The committee's report on Mr. Leeds' suggestions pushed it a step farther, and the election of a very prominent master car builder to a vice-presidency of the Master Mechanics' Association (a gracious act, the spirit of which the Master Car Builders' Association should have forestalled by electing a motive power man to its presidency instead of holding to its traditions) will have a tendency to make assurance of consolidation doubly sure."

"Railway Age"—"It has been unavoidable that there should be much discussion as to whether it was not a waste of energy to keep two separate associations going, with so much the same work, so largely the same membership and so many topics and interests in common. Year by year this discussion has increased and year by year the conviction has grown among the majority of members that one association, covering the whole field, could better and more economically perform the work now done by the two. Until this summer, however, the subject has, by common consent, been kept in the background, officially ignored and never appearing on the floor of either convention. At Saratoga last week a departure was made, and in the Master Mechanics' convention the question of consolidation was formally brought to the front, firstly, by some remarks made by the president of the association in his annual address, and, secondly, by a committee which was appointed to make recommendations on the subject matter of that address to the association. There is no question that the recommendations of the committee have the approval of the majority of the members of the Master Mechanics' Association. Whether the majority of the Master Car Builders also approve is more doubtful. That many of them do so is certain, and it is equally well known that others do not. But the sentiment in favor of consolidation is growing, and we imagine that the sympathy of managing officers generally will be entirely with it. There may be a year or two of delay yet, but the end cannot be far distant when 'The American Railway Mechanical Association' will take the place of the two existing organizations."

"Railroad Gazette"—"The movement to consolidate the two associations is not new, but it has long been going on quietly, and we judge that the result is inevitable. Some time the associations will be consolidated under perhaps an entirely new

name. Naturally, it will still take two or three years to bring this result about.

"One has only to look over the lists of railroad officers and to reflect upon the changes in their duties which he can remember to realize the development that is going on. The line between the superintendent of motive power and the master car builder has already pretty nearly disappeared on the great roads and largely disappeared on all roads. Or, let one look over the list of active and representative members of the Master Car Builders' Association; he will discover that the superintendents of motive power, master mechanics, mechanical engineers and others bearing titles which indicate that they perform general mechanical duties outnumber by about 70 per cent those whose titles indicate that their duties are confined merely to the car department. In fact, the business of designing, building and keeping up the car equipment has come to be a part of the one great department of railroad mechanical engineering. The irresistible movement is toward organizing this great department under one head. The men who build and repair cars are superintendents or foremen of shops or division master car builders; just as the men who build and repair locomotives are division master mechanics and foremen or superintendents of locomotive shops, and all are part of one mechanical organization. We estimate that this organization is as logical as it is inevitable.

"From this development it has followed that the membership in the two associations has come to be so largely the same that their work is in some degree duplicated. From this it must follow further that the artificial division into two societies of one body of men with one set of duties cannot last indefinitely.

"It has often been suggested in the last few years that if the two associations are not consolidated a third society will be formed. This society would naturally take the men who, by their rank or by their intelligence and activity are actually creating and developing the whole body of mechanical practice on the railroads—the men who have evolved and secured the use of the standards and who are working to advance the art—these are the men whose time and work is most valuable and who are most desirous of avoiding the waste which the present duplicate organization involves.

"There are many reasons why the establishment of a third society would be unfortunate, but we need not go into these now. A consolidation of the two existing associations would avert it for a long time."

HOW TO KNOW WHAT OTHERS ARE DOING.

A short time ago we learned of a plan followed by a prominent manufacturer, who had little time for reading, whereby his company obtained the benefit of all the new ideas brought out in the technical papers in the line of work in which the company was engaged. The papers were opened by a clerk and placed on the manufacturer's desk. He looked them over, and by means of paper slips indicated articles for examination by various heads of departments. These officers read the articles and briefly reported in writing upon their value as bearing on the work of the establishment, returning the papers for permanent file.

The results were seen in the form of improved methods, and it was possible for the concern to profit by the experience of others, in many cases the adoption of the ideas being materially improved upon before being used. The plan is an excellent one, and is worthy of imitation, especially in cases where the visiting of other shops is impossible or undesirable.

One of our most important railroads has its shop foremen spend a specified number of days each year in visiting the works of other roads as well as those of some of the large manufacturing establishments, with a view of obtaining the benefit of all of the latest improvements in use by other progressive people. This practice results in a great saving to the road and costs little, compared with the value of the new ideas obtained.

Speaking of improving shop organization at a meeting of the Western Railway Club, Mr. A. M. Waitt said: "I believe today the shops of our country could be greatly improved if we could arrange for enough time to let the foreman in the blacksmith shop, or the foreman in the machine shop, and others, go and spend a day or so at other shops; let the railroad pay his expenses and let him pick up what he can, and I do not believe there is a shop so poor in this country from which we could not learn something that is an improvement on our practice. I believe if railroad managers would encourage that practice in their higher officers, and have them go out and see what their neighbors are doing and then after getting home talk it over and try to get better results, a great deal could be done in improving the efficiency of our railroad organization.

"A road may be made up of a consolidation of a number of small roads that have been brought up on different principles of working. If the foreman can be sent to one shop to spend a day there and after a month go to another shop and spend a day there, talking and interchanging ideas with men in that shop, I believe that a great deal can be done in improving shop organization."

In the same discussion, in speaking of conferences among the men, Mr. F. W. Brazier, of the Illinois Central R. R., said: "We have a weekly meeting of all our foremen. We even call in the foreman of our laboring gang who cleans up the yards, and through the foremen we take up each engine and passenger car in the shop. We generally have 25 engines and 60 passenger cars. We will ask, 'What is this engine waiting for?' and if it is for boiler flues we ask the boiler maker what is the trouble with the flues, and if he answers that the storekeeper has not furnished them we will take it up with the storekeeper, who is present, and must explain when we may expect them. It is a regular school, and we find it is the best way to have our men meet each week and exchange thoughts and talk over the orders. Some foremen think: 'We do not care about the other fellow; we have got our work to do and we will do it.' Our weekly meetings draw out the department that is behind. Our foreman of tenders and passenger trucks and our foreman of freight trucks are all called in and each tells what he is lacking through the week. If it is bolts, we ask the blacksmith why he doesn't furnish them. If it is forgings, we ask the storekeeper if he has the right size iron, and in that way we usually keep each department posted and get the best results.

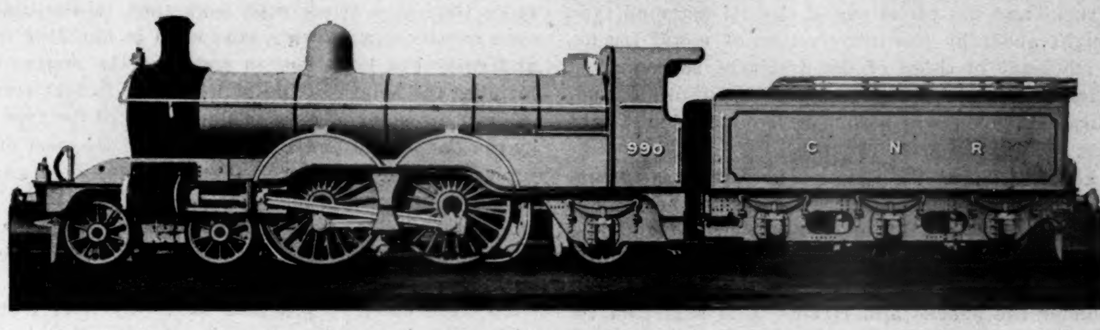
STRONGER M. C. B. COUPLERS FOR HEAVY CARS.

The use of cars of 100,000 lbs. capacity has brought to attention a number of important questions relating to the strength of various parts of car equipment, and particularly to draft gear and couplers. Mr. J. E. Simons stated at the recent M. C. B. convention that with trains weighing 2,100 tons, the pull on the draft gear on a 22-ft. grade was 9,000 lbs. above the capacity of the draft gear employed, although its capacity was sufficient for ordinary conditions. It is evident that draft gear designs need revising for these heavy pulls. The recent improvements in the Westinghouse Friction Draft Gear are interesting in this connection. Couplers also show weakness under the severe conditions, and the following quotations from a communication to "The Railway Master Mechanic" by Mr. A. M. Waitt is pertinent and suggestive:

"The present tendency seems to be undoubtedly in the direction of greatly increased capacity of cars; as a result of this, cars in motion will have much greater momentum, and all the parts of the equipment will be subject to greater strain. The present M. C. B. couplers were undoubtedly designed for cars of lighter capacity than many now in service. Unfortunately they were designed on such lines as to prevent their being properly strengthened within the same limiting dimensions. It is an open question whether the present M. C. B. lines are ideal in the way of producing a thoroughly satisfactory automatic coupler. I do not see any use in trying to strengthen one part of the present coupler, for instance the shank, and leave the head and knuckle the same as they are at present, for the coupler as at present made divides the breakage up between the knuckle, coupler head and shank in quite even proportions. If any general strengthening of the couplers is to be accomplished, it will in the end necessitate heavier knuckles, therefore a head which will not couple with the present heads. If such a change is sought for, it seems to me it would be better for an able committee of experts, from both the manufacturers and the railway men, to see if a design of coupler can be worked out, not necessarily on the present lines, but which will be large enough and strong enough for cars of double the present generally adopted capacity of 60,000 lbs., and in connection with it design a simple connecting piece that will enable one of the suggested new design of couplers to be properly connected with the present M. C. B. type. It is too late a day, in my opinion, to attempt to patch up and make strong and satisfactory the present M. C. B. coupler, which is far from ideal, although it is a vast improvement and source of economy as compared with the link and pin coupler."

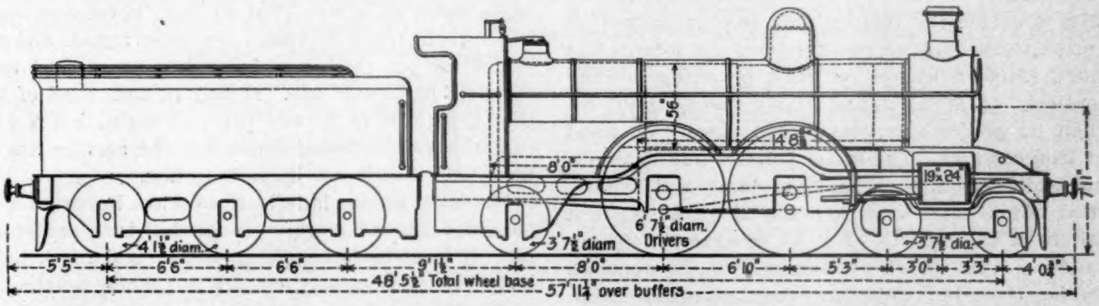
NEW LOCOMOTIVES, GREAT NORTHERN RAILWAY OF ENGLAND—ATLANTIC TYPE.

The accompanying engravings show the general appearance of a new Atlantic type engine recently built from designs by Mr. H. A. Ivatt, Locomotive Superintendent of the Great Northern Railway of England. The diagram shows the chief dimensions of the engine and wheels, and the accompanying list presents some information not shown in the drawing. The tender is carried on six wheels in pedestals and holds 3,650 gallons of water and 5 tons of coal. The heating surface and



"Atlantic Type" Locomotive, Great Northern Railway, England.

grate area are small for this type and yet the weight is enough for an engine with much greater boiler power. The greatest interest in the design is due to the selection of this type for service in England. There is reason to believe that some of the difficulties recently referred to in discussions of the speed and power of English engines may be overcome by further work in this direction, and we expect to see more designs of this type. This engine has an extension front formed by setting the front tube sheet back into the barrel of the boiler. Macallan's variable blast pipe is used, giving a variation of from 5 to 5½ inches in diameter. The cylinders are 19x24 inches; the total weight of the engine is 129,930 pounds, that



"Atlantic Type" Locomotive, Great Northern Railway, England.

of the tender when loaded being 91,616 pounds. The following further particulars are interesting:

Weight on drivers	69,440 lbs.
" " front truck wheels	33,600 lbs.
" " trailing wheels	26,880 lbs.
" total	129,920 lbs.
Wheel base, total, of engine	26 ft. 4 in.
" " driving	6 ft. 10 in.
" " total (engine and tender)	48 ft. 5½ in.
Length over all (engine and tender)	57 ft. 11¼ in.
Height, center of boiler above rails	7 ft. 11 in.
Heating surface, firebox	140 sq. ft.
" " tubes	1,302 sq. ft.
" " total	1,442 sq. ft.
Grate area	26.79 sq. ft.
Steam pressure	175 lbs.
Drivers, diameter	79½ in.
Truck wheels, diameter	43½ in.
Cylinders, diameter	19 in.
Piston, stroke	24 in.
Main rod, length center to center	10 ft.
Tubes, number	191
" outside diameter	2 in.
" length over sheets	13 ft.

Government tests of the Sims dynamite gun are being made at Mattinecock Point, Long Island, compressed air being used to throw the dynamite projectile. It is said that a range of five miles has been covered, but the detailed records of the tests have not yet been given out.

STANDARD TRUCKS.*

By E. D. Bronner.

Judging from past experience, I should say that we cannot agree on a standard, and even if we were to adopt a recommended practice it would not be largely followed. A standard adopted and fully recognized would impede progress. It would amount to very little in the end, as the practical results sought could be largely accomplished by the adoption of standard parts. To determine what the parts are that fail largely, I have analyzed the truck repairs on our road for one month. These are the running repairs made at outside repair stations and do not include heavy repair at the shops. The total number of cars receiving repairs of any kind was 9,864. The truck repairs were divided as follows:

Wheels and axle (including journal bearings in a majority of cases)	825
Journal bearings only	988
Journal bearings, wedge	57
Journal box bolts (about 72 per cent. alone)	317
Truck column bolts	173
Truck column guide bolts	163
Arch bars	86
Tie bars	4
Swing hanger pivot casting bolts	2
Bolts in Fox truck (jaw)	2
Swing hanger	31
Swing hanger pivot	17
Center pins	273
Truck truss rods	39
Journal box	42
Journal box covers	14
Truck column	27
Bolster guide block	20
Swing hanger pivot casting	25
Swing hanger casting	4
Spring plank casting	8
Truck bolster chafing plate	3
Truck bolster	34
Truck transom	15
Spring plank	25
Truck springs	40
Nuts without number	
Total	3,234

It will be seen that a large percentage of the repairs is on account of wheels and axles, journal bearings, journal boxes and covers, journal bearing wedges and journal box bolts. These we have standardized for several classes of trucks, and if they were adopted and used by all our members it would obviate much of the difficulty in making truck repairs. On the whole, I shall say, let us give up "rainbow chasing" and save

* "Merits of Diamond and Steel Plate Types." Discussion before M. C. B. Convention, June, 1898.

the time and labor spent in trying to adopt standard trucks. If we can get standard wheels and axles, journal bearings and wedges, journal boxes (which determine their bolts) and possibly standard cross sections for arch bars and diameter of column bolts for 60,000, 80,000 and 100,000-pound trucks, we will get all we can ever hope to compromise on in the present stage of the car builder's art, and practically all that will be necessary.

A great many designs for metal freight car trucks have been brought out, but my experience has been limited to two general classes—the type represented by the Fox, Cloud, Schoen and Hewitt trucks and the variations of the old diamond type of truck brought about by the introduction of metal trucks. The relative efficiency of those of the first type as compared with each other would be a difficult matter to determine, and, not having any data upon which to base a conclusion, I will leave the point for discussion by others.

With both kinds of trucks the function performed is to sustain the weight on the center and distribute it to the journal boxes. The trucks must do this over good surface and bad surface, over curves and tangents, at low speed and at high speed. To do this efficiently the truck must retain its shape in all respects under the shocks and strains it is subjected to. It must remain square to keep the flange wear of the wheels and the train resistance at a minimum. The cross girders or bolsters must show little deflection so that too much weight will not be thrown on to the side bearings, and thus increase the resistance to curvature. The transverse strength of the cross girders, transoms or bolsters must be sufficient to resist the shocks of sudden applications of the brakes and buffing. The wheel shock must be cushioned in a manner to produce the least detrimental effect on the structure of the truck or body and also the track. It should be of such design, construction and material that failure of parts will be reduced to a minimum. Failure in detail increases cost of maintenance and decreases safety. It should not have too many vital parts which might, by the failure of any one, wreck the truck, the car or the train.

We must also consider the facility and ease of inspection and repairs or replacements of parts subject to wear. The modern diamond frame truck, either rigid or swing motion, constructed entirely of metal, more nearly meets these requirements than its predecessor constructed largely of wood and with gray iron castings. The metal bolsters and channels are more rigid and less liable to sagging, decay and failure. The introduction of malleable iron parts has also resulted in a decrease of failure of those parts. But let us examine the repair records and see what are the weaknesses of the diamond truck, and whether these improvements would eliminate them. We find that the various wrought iron parts and bolts still remain; that the truck still depends upon too many vital parts; that it is still subject to failure in detail.

It might be said that the larger and heavier parts in the modern trucks will resist more effectually the shock and strains that they are subject to. In this conclusion I think that we would be largely in error, as there have been many well-designed trucks under our older and smaller capacity cars, which were fully as good for their class, barring the metal bolster, as the trucks under our large capacity cars. The latter are merely an enlargement to meet the greater carrying capacity of the cars and still embody all the vital parts and probably most of their weaknesses. These parts are failing as in the past, and these failures will increase as the cars get older and the carrying capacity greater.

The diamond frame type of truck was a better type for small capacity cars than it will be for 60,000, 80,000 or 100,000-pound capacity cars. The frame is still subjected to all the wheel shock uncushioned and the strains induced by trying to force four wheels held in a rigid frame into contact with rail surfaces not lying in a plane. With our 60,000 and 80,000-pound trucks, we retain the same wheel base as in our lighter trucks, but enlarge and stiffen the parts to carry the increased load, thus robbing them of a certain amount of elasticity which the lighter trucks possessed; otherwise, I am unable to understand the large number of failures of arch bars in diamond trucks of large capacity and heavy parts which I have noted. In the matter of inspection it is true that the arch bar truck permits an easier inspection of wheels than a plate truck, but the frame of a plate truck having so few vital parts, and being subject to so few failures, requires less time for inspectors and permits more time to be devoted to the wheels.

In the matter of repairs, the replacement of wheels requires more time in a truck with jaws than in the diamond truck, even considering the time consumed in handling inside wheels and rusty box bolts, but in weighing the matter we must remember the length of life of wheels in freight service.

From my point of view, a plate truck of the type represented by the Fox, Cloud and Hewitt trucks is the most efficient truck for cars of large capacity. Properly designed and built in a proper manner with the right material, they will retain their shape in service, thus reducing train resistance and flange wear. The cushioning of the entire structure above the journal boxes decreases cost of maintenance.

To come down to practical facts, the road I am connected with owns but fifty cars equipped with Fox trucks, but we handle New York Central, Erie and Lehigh Valley cars equipped with these trucks in large numbers, so that our men are perfectly familiar with them. The only failures that have occurred on our lines were two cases when the trucks first came out. The side girders failed, beginning with a fracture at the bottom flange, near the cross girder, and passing up through the rivet holes. It developed gradually. Since then we have had practically no running repairs to frames whatever on the many thousands of these trucks which we have handled. Our foremen all report satisfactory service for all such trucks coming under their observation. We know that the earlier designs developed some weakness and have been changed once or twice, and, for all I know, when they get home to the owners, they may be like the "old one-hoss shay" and break down all at once, but we have never seen anything of it. The type of truck is what I am referring to, although in talking of my practical experience with the type I am obliged to handle a particular one. It may be that none of the trucks of that type now in service are just right, but I firmly believe that the most efficient truck for the service lies along those lines, and that it can be built to last.

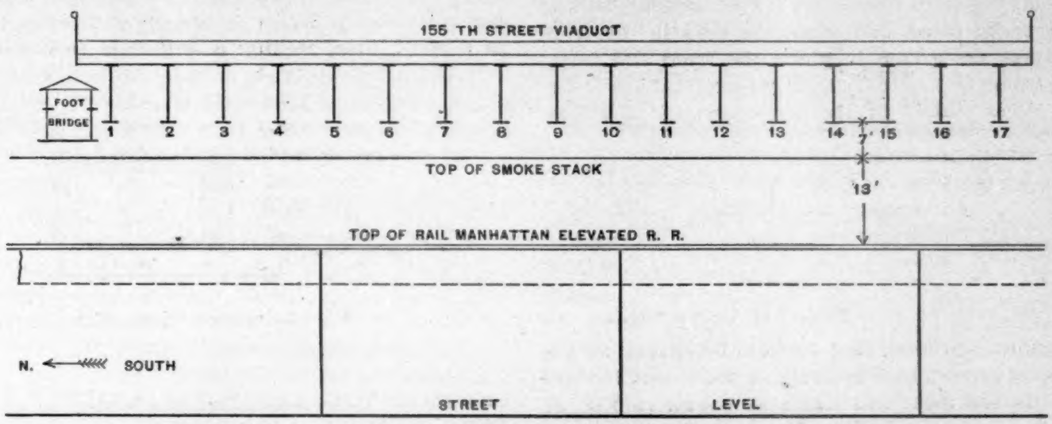
The body bolster is fully of as much importance as the truck bolster, although more attention has been centered in the latter. It is of little benefit to get a rigid truck bolster if your body bolster sags and permits too much weight to be carried on the side bearings, as side bearings are generally constructed. Go through any railroad yard, and what do you see? Body bolsters all sagged at the ends, especially the wooden ones. A wooden body bolster can no more be preserved in line in practical service than a wooden truck bolster can.

LIGNITE FOR LOCOMOTIVES.

In a paper before the Texas Railway Club Mr. S. R. Tuggle, Superintendent of Motive Power, Houston & Texas Central Ry., told of the results of experiments with lignite as fuel on that road. It was specially desirable to use this fuel if possible, because of an abundant supply of it in beds on the main line of the road. It was first tried for the boilers of water stations, then at the car shops and creosoting plant, and then under all stationary boilers. By changing the draft appliances and putting on diamond stacks it was found that lignite alone could be burned on switching engines, and that a mixture of about equal parts of lignite and Territory or 'Frisco coal was suitable for road engines. Fuel records of this road show that in January, 1896, in all classes of service, the locomotives made 29.9 miles per ton of coal at a cost of 11.06 cents per locomotive mile, while in January, 1898, corresponding figures are 28.3 miles per ton of coal, costing 6.41 cents per mile, or a reduction of 4.65 cents per locomotive mile. The following comparative figures by years were also given. Average cost of fuel per locomotive mile: 1894, 9.55 cents; 1895, 7.99 cents; 1896, 7.68 cents; 1897, 6.54 cents. Lignite was first used in 1895. Besides the saving from the reduced cost of the fuel, Mr. Tuggle said that an indirect saving was effected by decreased expenses for repairs to locomotives.

COMPARATIVE PAINT TESTS ON THE 155TH STREET VIADUCT, NEW YORK.

The plan adopted during 1897 by Mr. E. P. North, then Consulting Engineer of the Department of Public Works, New York City, for making comparative tests of various kinds of paint under the severe action of locomotive gases was outlined on page 375 of our November, 1897, issue. Mr. North having resigned his position, the work of comparison was intrusted to Mr. Henry B. Seaman, 40 Wall street, New York, whose report we are permitted to print. The girders were cleaned in exactly the same way and the 17 different paint firms were permited to apply their paints under equally favorable conditions, which renders this comparison absolutely fair to all. Mr. Seaman, at his own request, was not informed of the brands of paint used, nor did he know the names of the firms concerned until after the completion of the comparison.



Sketch Showing Positions of Girders, 155th Street Viaduct, New York.

We reproduce Mr. Seaman's report in his own words, as follows:

The knowledge to be gained from this experiment will be very valuable, and, while the paints had been exposed for less than a year at the time of Mr. Seaman's examination, the comparison given by him is interesting. It is not by any means certain that the classification of condition would be exactly the same if examined by other individuals, but these results may be taken as the carefully prepared opinion of a disinterested engineer.

On April 12, 1898, I made an examination of the different paints on that span of the 155th street viaduct, which is directly over the tracks of the Manhattan Elevated Railroad at Eighth avenue, and beg to submit the following report:

This part of the bridge spans three tracks and two platforms, at the 155th street station of the elevated railroad, and is composed of seventeen lattice girders carrying floor beams upon which are riveted buckle plates, which in turn carry the roadway of the 155th street viaduct. These seventeen girders are of 69 feet span and 9 feet deep, being spaced 9 to 10 feet apart, and having the bottom flanges about seven feet above the tops of the locomotive stacks. For convenient reference in this report, these girders are numbered from 1 to 17 consecutively, beginning at the north end.

A foot bridge, located just north of girder No. 1, also crosses above the tracks. The floor of this bridge is about four feet below the bottom flange of girder No. 1, and about three feet away from it in the clear. The 155th street station being the terminus of the railroad, the two outside tracks are in constant use by arriving and departing trains, while the middle track is used mainly by switching locomotives.

During the greater part of the day, trains arrive three minutes apart, alternating between the easterly and westerly tracks. The locomotives of the north bound trains on the easterly track stop with the stack directly under girder No. 5, and remain about 20 seconds before pulling out. Incoming trains on the westerly track do not stop until the locomotive has passed north beyond the footbridge. All trains approach the station with steam shut off, except that used for brakes. It will thus be seen that the only girders which constantly receive the direct blast of the engine are girders No. 1 to 5 inclusive, the remaining girders receiving blasts only upon the occasional switching of engines, and in making up trains. In all other cases the girders are exposed alike to only such gases as the locomotives emit while the steam is shut off.

In making the examination, a careful general scrutiny was given to each girder from the platform below, and each was given a percentage mark, denoting the amount of surface free from rust. These percentages were then carefully compared and reviewed so that they might correctly represent the comparative condition of each girder. When these results were completed, a thorough inspection was made by climbing through the structure and the character of rust noted, for each girder.

After completing the examination and recording the results, the kinds of paint used for each girder with the number of coats and comparative rapidity of drying were obtained from Mr. M. E. Evans, C. E., under whose direct supervision the girders were cleaned, and the various paints applied. The following table gives the summary of the results:

COMPARISON OF PAINTS.

Number of Girder.	Kind of Paint.	Number of Coats.	Rate of Drying.	Percentage of Surface Free from Rust, April 12, 1898.	Remarks Concerning Condition of Paint.
1	Lead, Graphite and Lucol Oil..	3	Medium.	97	Paint crumbling in places, as though rotten. Very little rust.
2	Graphite and Linseed Oil..........	2	Slow.	80	In fair condition, but discolored. Rust coming through.
3	Red lead. "Antoxide F." "Antoxide D."...........	2	Rapid.	25	Very badly rusted.
4	Graphite	2	Slow.	75	Rust not deep.
5	"Nobrac".	3	Medium.	99	Slight rust on top flange of one panel. Rest of girder clear.
6	"Carbon Black"....	2	Slow.	85	Rust not deep.
7	"Durable Metal Coating"......	2	Slow.	75	Rust not deep.
8	"Black Manganese Iron"......	2	Rapid.	30	Rust very deep. Buckle plates bad.
9	"Carbonizing Coating"........	2	Slow.	80	Rust not deep.
10	"Mineral Rubber"............	4	Rapid.	78	Area of rust spots small Rust very deep.
11	"Black"........................	2	Medium.	58	Rust bad and deep.
12	Carbon..............	2	Medium.	92	Rust not deep.
13	Graphite	2	Medium.	67	Rust not deep.
14	Graphite	2	Slow.	70	Rust not deep.
15	Asphalt	2	Very slow.	65	Deeply rusted. Buckle plates still good
16	"Ruberine".....................	2	Medium.	58	Rust deep and angry. Buckle plates mildewed.
17	"Black Diamond"...............	2	Medium.	70	Small pimples of rust, as though formed under paint.

It will be noticed, both by percentage of clear surface and character of rust on close examination, that girder No. 5 is preserved better than any other of the set. When it is also considered that the priming coat of this girder was the one first applied, that it has been the most severely exposed to sulphur fumes, and that a portion of the priming coat was applied with the humidity averaging 96 per cent. for the day (where 100 per cent. is absolute saturation), the comparative condition in favor of girder No. 5 is very marked. Respectfully,

HENRY B. SEAMAN.

New York, May 24, 1898.

COMMUNICATIONS.

LOCOMOTIVE FRAME FASTENINGS.

Editor "American Engineer":

Referring to the recent report on the best form of cylinder fastenings for locomotives at the Master Mechanics' Convention, I send you a print showing a frame construction which seems to me far superior to anything suggested in the way of double front end frames for ten-wheel locomotives. This is somewhat like the last sketch, Fig. 31, in the report referred to, but the strong point in this arrangement is considered to lie in the fact that the main frames are slotted off together and the cylinder properly faced, and when the keys in the front cylinder fastenings are driven in place, the front end frame pulls the main frame and cylinder tightly together, thus wedging the three pieces closely by the one operation of keying.

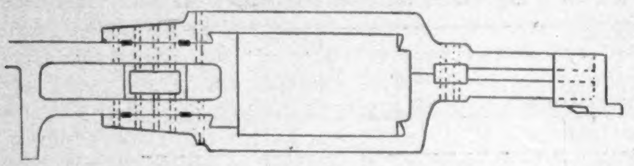
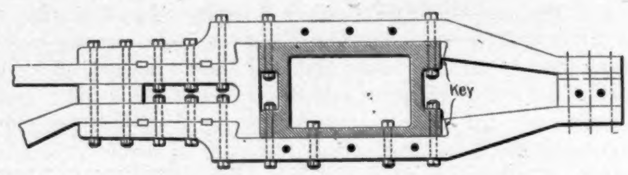


Fig. 31.—Reproduced from Report of Committee.



Plan Suggested by Mr. Henderson.

If this has been done properly the vertical bolts may be applied and the whole frame held securely in place; but if there are any offsets in the front end frame as shown in Fig. 31 of the report, it is likely that the effect desired will be lost by the offset of the frame itself bearing against the cylinder, and thus preventing the binding action desired between the cylinder and the main frame.

We think that this is a question of sufficient importance to interest locomotive designers, and I would be glad to hear through your columns any criticisms or suggestions upon this method.

G. R. HENDERSON,
Mechanical Engineer.

Norfolk & Western Ry.
Roanoke, Va., June 23, 1898.

ADVANTAGES OF RELATIVELY SMALL GRATES.

Editor "American Engineer":

In recent discussions of the importance of large locomotive boilers, an equally important factor has been forgotten, viz: The grate area. I ought to put this in another way in order to be understood and will say that, ordinarily, locomotive grates are too large for economical combustion and the large grate idea has been an expensive fad. The tide now seems to be setting in the direction of increasing the ratio between heating surfaces and grate areas, which I heartily approve. A comparison, printed on page 436 of the "Railroad Gazette" of June 17, 1898, shows that the grates of the Class H—3a engines, built in 1889, have much larger grates than the most recent design, Class H—4, which has just appeared. The part of the table which is pertinent in this connection is as follows:

	Class H—3a.	Class H—4.
(1) Total weight	124,800 lbs.	174,300 lbs.
(2) Total heating surface	1,498 sq. ft.	2,470 sq. ft.
(3) Grate area	31.5 "	29.7 "
(4) Ratio of (3) to (4)	1 to 48	1 to 83
(5) Cylinders	20 × 24 in.	22 × 28 in.

The later design is for a bigger and heavier engine, requiring a bigger boiler, but the Pennsylvania people have reduced instead of increased the grate area, and the ratio between the heating surface and the grate area has been considerably increased. The ratio obtaining in the H—4 design is probably about right, and I want to indicate that high ratios between these surfaces have not been fully appreciated Large heating surfaces are all right as far as they go, but the grates must be made to correspond. We do not hear enough about the grate nowadays. Most big engines with large grates will save coal if parts of the grates are blocked up by dead plates until the right ratio is obtained.

C. G. O.

July 2, 1898.

SERVICE TESTS OF AIR BRAKE HOSE.

Editor "American Engineer":

I would like to call your attention to some facts relative to air brake hose tests, which modify to some extent the tests recently recommended. The best hose for air brake purposes is manifestly that which gives the longest service. Now the tests proposed by some roads and manufacturers are empirical and mere guess work, inasmuch as they in no way are based on the service use of the hose.

The unwinding test for the friction is an instance. In place of indicating the longest lived hose, this test actually requires such a peculiar condition of the rubber as to make a very short lived hose. To meet the unwinding test, a soft, sticky rubber is necessary, which is in such a crude state as to harden in a short time, making a stiff hose very liable to crack if bent short. Some time since the writer, in company with a master car builder, took from a freight car an air brake hose that had been in use some five months, which hose was one of a lot accepted on this unwinding test. A section 1 inch long was cut from it and the 25-lb. weight applied to unwind the friction or fabric. It failed so badly as to surprise us, and indicated clearly that the condition of rubber necessary to pass this test when the hose is new is such as to harden quickly, making a hard, rigid hose in a few months of service. A hose on another car, probably costing less than the one experimented on, had been in use over a year and was quite pliable, yet I doubt if it would at any time have passed the unwinding test. Inasmuch as what a road wants is hose that will give the longest life, the logical requirements would seem to be such as demand a certain life of say two or three years or a certain mileage, as required of cast freight car wheels, which requirements have given the best and cheapest freight car wheel in the world.

Let roads require a service test of 30 months, and leave it to the manufacturer to make his hose of any mixture of rubber he deems best. By so doing better and cheaper hose will result, because so far the mixture of rubber necessary to give the largest service is not known, and for railroad officials to dictate what mixture shall be used as indicated by tests which in no way test the hose in the line of its use approaches the absurd. What the road wants and pays for is service, not a sticky, quick-changing friction, and by requiring a service of two or three years the road throws upon the manufacturer the responsibility of filling it whereas the unwinding test relieves the manufacturer of making hose that will give over six or eight months' service, and the road itself assumes the expense entailed by short lived hose. New constructions of hose will come out which cannot be tested at all by this unwinding test, and which hose will likely give three times the life of the present kinds. How then can such hose be tested save by its actual use? Does the Government, in buying armor plate, require elongation tests of samples or tensile strength tests, or does it take a plate and submit it to a test of actual service by attacking it with high power guns? Rather the latter, and by so doing that is leaving the manufacture of the armor to the manufacturer entirely, and by demanding a practical test identical with the use the armor is to be put to, it has secured so much the best armor, at the expense of the manufacturer, that foreign governments are using American armor. Let the railroads adopt similar tactics—which are identical with those which experience and common sense forced them into in the case of cast car wheels, and they will soon reach the desired end of the longest lived air hose.

MASTER MECHANIC.

July 4, 1898.

TIMBER TESTS BY THE GOVERNMENT.

The Government timber tests by Prof. J. B. Johnson, in 1897, have been recorded in a pamphlet circular No. 18, by the United States Department of Agriculture, the special field covered being the influence of the size of test specimens upon the results, the effect of distribution of moisture, and the relation of compression-endwise strength to the breaking load of beams. On page 229 of our issue of July, current volume, we printed a statement of the conclusions reached by Mr. Fernow on the discovery by Mr. S. T. Neeley, of the direct relation between the compressive and transverse strength of timber, and below we give the most important conclusions drawn from the 1897 tests. For lack of space we cannot give the complete text of the report.

Conclusions.

1. A difference in strength values derived from a few specimens of the same kind of wood, up to 10 per cent. for coniferous wood and 15 per cent. for hard woods, cannot be considered a difference of practical importance; such differences cannot be relied upon as furnishing a criterion of the quality of the material.

2. The size of the test piece does not in itself influence strength values (except in compression endwise when the size is less than a cube).

3. Small test pieces judiciously selected furnish a better statement of average values of a species than tests on large beams and columns in small numbers.

4. A large series of test on small pieces will give practically the same result as such a series on large beams and columns; hence there is no need of finding a coefficient, with which to relate the results of the former to construction members.

5. The influence of moisture on strength appears even greater than the former tests and statements from this division have indicated.

6. The strength of beams at elastic limit is equal to the strength of the material in compression, and the strength of beams at rupture can, it appears, be directly calculated from the compression strength; the relation of compression strength to the breaking load of a beam is capable of mathematical expression.

Effect of Water Soaking.—A series of 132 compression endwise tests on pieces of white pine, longleaf pine, tulip tree (poplar), oak and ash made on material which had been yard dry and then soaked in cold water for over four months, showed that this soaked material behaved very much like the green material, displayed but little less uniformity, and that the difference between soaked and dry material was about the same as between green and dry material. For purposes of investigation the green material was found preferable to soaked pieces, since much time is lost in soaking and a uniform distribution of moisture not readily attainable.

Observations and Deductions.

(a) The difference between the values for the large beam and the average for the small beams is not at all constant, either in character or quantity; the large beam may be stronger (20 per cent. of the cases) or practically as strong, i. e., within 10 per cent. (57 per cent. of the cases), or it may be weaker and vary often considerably from the average (23 per cent. of the cases). Of 696 tests on small beams 235 furnished results smaller than that of the large beam. Again, out of 396 small beams, fully 40 per cent. were weaker than the large beam, while of another series of 300 only 24 per cent. gave lower values.

(b) There are in every case some small beams which far excel in strength the large beam; even in such cases where the average strength of the small beams is practically the same as that of the large beam, some small beams show values 25 to 30 per cent. greater than the large beam.

(c) In only 6 per cent. of the cases each of the small pieces gave a higher result than was obtained from the large beam, but in these cases the latter was evidently defective.

(d) In all beams the differences observed between the several small beams themselves are far greater than that between the average value of the small beams and the value of the large beam from which they are cut.

From these observations, which are fully in accord with the observations on the numerous tests of the large general series, it would appear that—

(1) Size alone can not account for the difference observed; and, therefore, also that a small beam is not proportionately stronger because it is smaller, for it may be either stronger or weaker; but that if it is stronger, the cause of this lies in the fact that the larger beam contains weak as well as strong wood, besides other defects which may or may not appear in the small stick.

(2) Generally, but not always, a large timber gives values nearer the average, since it contains, naturally, a larger quantity as well as a greater variety of the wood of the tree; and, therefore, also:

(3) Small beams, for the very reason of their smallness, containing, as they do, both a smaller quantity and variety of the material, give results which vary more from the average than results from large beams, and, therefore, can be utilized only if a sufficient number be tested; but it also appears that:

(4) To obtain an average value, even a very moderate number of smaller pieces, if they fairly represent the wood of the entire stem, give fully as reliable data as values derived from a larger beam.

(5) Average values derived from a large series of tests on small but representative material may be used in practice with perfect safety, and these averages are not likely to be modified by tests on large material.

It might be added that both the practicability and need of establishing a coefficient or ratio between results from tests on large and small beams or columns falls away. To deserve any confidence at all, only a large series of tests on either large or small beams would satisfy the requirement of establishing standard values, while a series of small pieces has the preference, not only on account of greater cheapness and convenience in establishing the values, but still more for the reason that only by the use of small, properly chosen material is it possible to obtain a sufficiently complete representation of the entire log.

INACCURATE WHEEL RECORDS.

The paper on "Thermal Tests for Car Wheels," printed in abstract on page 249 of our July issue, contained a discussion of the ordinary methods of arriving at the average life of chilled iron car wheels. Mr. Bush says:

If we have, for example, 10,000 wheels in service, and experience for a period of ten years shows that in order to keep the equipment in good condition it is necessary to renew 1,000 wheels a year, it is obvious that the life of each wheel in service will be ten years; or, in other words, if the number of wheels drawn and renewed each year is sufficient to keep the equipment in good condition, the life of the wheels is obtained by dividing the total number in service by the number drawn per year.

Without considering the various influences that may come into such a calculation in ordinary practice, this may seem an entirely correct method, but it only applies when the equipment remains the same from year to year. If additions are made to the equipment a disturbing influence is immediately introduced. Also, it is assumed that the total number of wheels put under an owner's cars by foreign roads is the same as are put under foreign cars by the owning road, and finally that the mileage made by owner's cars on foreign roads is equal to the mileage made by foreign cars on the owner's road. These assumptions may or may not be true, and whatever results are obtained the figures thus deduced can at best only be approximate.

The method indicated above is quite commonly used As showing the inaccuracies of this method, however, it is only necessary to point to the following example:

According to this method, the life of wheels drawn during the year 1890 on one road was 7.4 years, while the life of wheels drawn on the same road in 1892 was 12.4. This difference in the life is due to the fact that for two years prior to 1890 large additions had been made to the equipment without a corresponding drawing of wheels; consequently the total number of wheels in service increased very greatly, while the renewals did not increase proportionately until 1892 and after. Again, in 1892 on the same road a very large addition to the equipment took place, with considerable diminution in the number of wheels drawn. This produced a very long life for such wheels as were drawn.

It must be evident, without argument, that there is no such

violent fluctuation in the life of wheels under cars. If necessary allowances are made for the variations in the equipment, etc., above indicated, a very different result is obtained. For example:

If the average of the total number of wheels in service for five consecutive years be taken, and this sum divided by five, and the yearly average of the wheels drawn for the same five consecutive years be taken, then we obtain the average life in years for the wheels drawn, which applies with considerably greater accuracy to the last one of the five years in question. Again, if we drop the figures for the first year of the group and take the figures for the succeeding year, we obtain another average life of years corresponding to the wheels withdrawn during the last year, and so on.

If objection is raised to a period of five years, it may be stated that by increasing the period, greater will be the accuracy. The table given below shows the average life of wheels obtained on a road by each of the plans outlined above.

AVERAGE LIFE OF WHEELS IN YEARS.

Year.	Five-year Plan.	Ordinary Plan.
1887	9	8.7
1888	8.5	8
1889	8.5	9.7
1890	8.4	7.4
1891	8.5	9.2
1892	9.2	12.4
1893	9.6	10.3
1894	9.6	9.5
1895	9.4	7.2
1896	9.3	8.8

AVERAGE WHEEL MILEAGE.

Year.	Five-year Plan.	Ordinary Plan.
1887	114,936	105,824
1888	108,280	99,080
1889	106,256	115,232
1890	104,056	94,456
1891	105,504	108,640
1892	111,024	137,776
1893	113,364	109,984
1894	107,496	95,144
1895	102,829	80,008
1896	99,446	89,083

It will be observed that the violent fluctuations produced by the first method almost disappear by using the second method, and the life of wheels expressed in years is much the same from year to year, which is really what might be expected, there being no real reason why the average life of wheels should change very greatly.

CARBON CONTENTS OF PISTON RODS.*

J. E. Johnson, Jr.

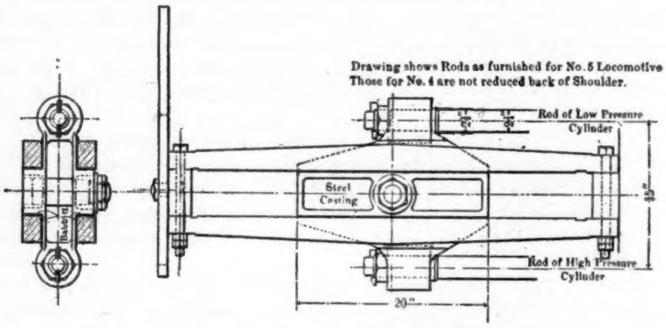
About six years ago the company with which the writer is connected bought a compound locomotive of the Baldwin or Vauclain type, no description of which is needed before this society, except to recall the fact that the high and low pressure cylinders lie as close together as possible, one vertically above the other, the rods from the two cylinders being fastened to the same crosshead, which is of the four-bar type, and located centrally between the two rods, as shown by the accompanying drawing. The wings or guiding surfaces are made very long in the direction of the stroke, to overcome the torque set up by the unequal and constantly varying pressures on the high and low pressure pistons respectively. These pressures are made as nearly equal as possible by the steam distribution, but practically there is always considerable difference at some part of the stroke, so that there is a stress tending to tilt the crosshead one way during one stroke, and the opposite way during the other. This stress, occurring while the crosshead is undergoing its regular reciprocating motion, puts a considerable pressure on the diagonally opposite corners of the guiding wings, and, the reciprocating motion going on while under this pressure, wear takes place on the corner of the wings first, and allows a slight rocking of the crosshead, a complete oscillation occurring at each revolution when running under steam.

The piston-rods are fastened to the crosshead with the regular taper fit drawn up to a shoulder by a nut. This connection being rigid, and the opposite ends of the rod prevented from vibrating with the crosshead by the fit of the pistons in the cylinder, the rods are bent at the shoulder through a very small arc in each direction vertically, at each revolution.

This first locomotive ran for three years and two months, when a duplicate was bought, and the first put in the shop for a general overhauling previous to taking the place of the smaller engines on another part of the road, the new one taking the run of the old one. During the overhauling the piston-rods were renewed, having worn down too small to work well with the metallic packing any longer. The material for the new rods was ordinary "machinery steel," taken from stock on hand. The rods on this engine (No. 4), it should be stated, were straight from shoulder to shoulder, while those of the "duplicate" (No. 5), were reduced in the body, having a collar ¼-inch larger than the rod and ½-inch wide next to the shoulder at the crosshead end.

After having been in service about fourteen months, one of the low pressure rods of No. 5 "let go" and smashed the cylinder head, without, however, doing any very serious damage. Within a few weeks the overhauled engine did the same thing.

This was becoming a serious matter, and after some careful consideration the writer ordered some genuine Swedish iron to make rods of. It was beautiful stock, and so soft that it acted almost like lead in the lathe, being very difficult to get a smooth finish on. A set of these was put into one of the engines at once and ran about four months, when one of them let go in the same way. The rods that broke were all low pressure ones, due undoubtedly to the fact that in the "emergency," or starting gear, those cylinders get almost full boiler pressure—180 pounds per square inch. The rods were all broken in the same way, and right in the shoulder the metal cracked at top and bottom, and the crack gradually widened, as could be seen by the worn appearance of the upper and lower segments of the break, which gradually approached each



C rbon Contents of P ston Rods.

other until only a narrow horizontal strip of solid metal was left across the middle of the rod when the final rupture occurred.

Soon after ordering the Swedish iron, the writer came across one or two articles bearing upon this subject of the endurance of soft and hard steel or iron under fatigue, and describing tests made to elucidate this point, notably those of the Pope Tube Company and the Bethlehem Iron Company, which showed quite clearly that high-carbon steel was infinitely better than low-carbon, and that nickel steel was better than either for such service; also that very soft material, like Swedish iron, lacked endurance under fatigue.

Therefore the breaking of the rod of this material was not a very great surprise, and was met by ordering metal for a set of rods of high-carbon and one of nickel-steel from the Bethlehem Iron Company. These have now been in considerably over a year, and we hope that they will last long enough to wear out without breaking.

The writer had the three rods which had broken, and the one which had worn out, analyzed, to see how they bore out the theory of high-carbon material versus low.

The results are given herewith:

	Sulphur.	Manganese.	Phosphorus.	Silicon.	Carbon.
First rod in No. 4 locomotive; machine steel; ran three years and two months without breaking	.094	.70	.082	.014	.466
Second rod in No. 4 locomotive; machine steel from Longdale stock; ran fifteen months and broke	.056	.64	.125	.021	.152
First rod in No. 5 locomotive; iron; ran fourteen months and broke	.020	.12	.04	.148	.129
Third rod in No. 4 locomotive; Norway iron; ran four months and broke	.006	.05	.055	.021	.044

*A paper read before the American Society of Mechanical Engineers, June, 1898.

It will be seen that these results bear out the theory to a striking extent, there being nothing in No. 1 to cause its far greater endurance except the carbon, and possibly to a slight extent the sulphur, which is also claimed by some to be a hardener.

It is very difficult to deduce any quantitative results as to number of reversals of stress producing flexure even approximately, because even given the approximate daily mileage of the engines and the size of the drivers, it is impossible to say what portion of the daily running was done under steam, the grades being quite heavy, and the trains running by gravity for nearly half the total distance.

If 30 miles per day under steam, 28 days per month, be taken, the diameters of the drivers being 36 inches, the revolutions per day would be, say 16,000, and per month, say 450,000; this would make for the second and third rods about 6,000,000 double flexures before rupture, and for the Swedish iron rod, say 1,800,000.

There is no way of giving the amount of flexure; the cross-head probably never tilted more than 3-64 inch in 24 inches to either side of the vertical; but this amount varied as the wear occurred, and was taken up; also, it is not possible to tell what portion of the total length of the rod absorbed this flexure, so that it is impossible to give any figures having a scientific value.

ELECTRIC MINE LOCOMOTIVES.

The development of electric locomotives for the special work of mine haulage, involving many difficult problems, has been successfully carried out by the Baldwin Locomotive Works and the Westinghouse Electric & Manufacturing Company, under the direction of Mr. George Gibbs, Consulting Engineer, and the recent work in this direction is described by these concerns in a pamphlet, from which the following information is taken:

Electricity has become established as the most convenient and economical form of motive power for mine haulage. It is especially suitable because of its flexibilty, permitting ready extension or change as mining conditions frequently require.

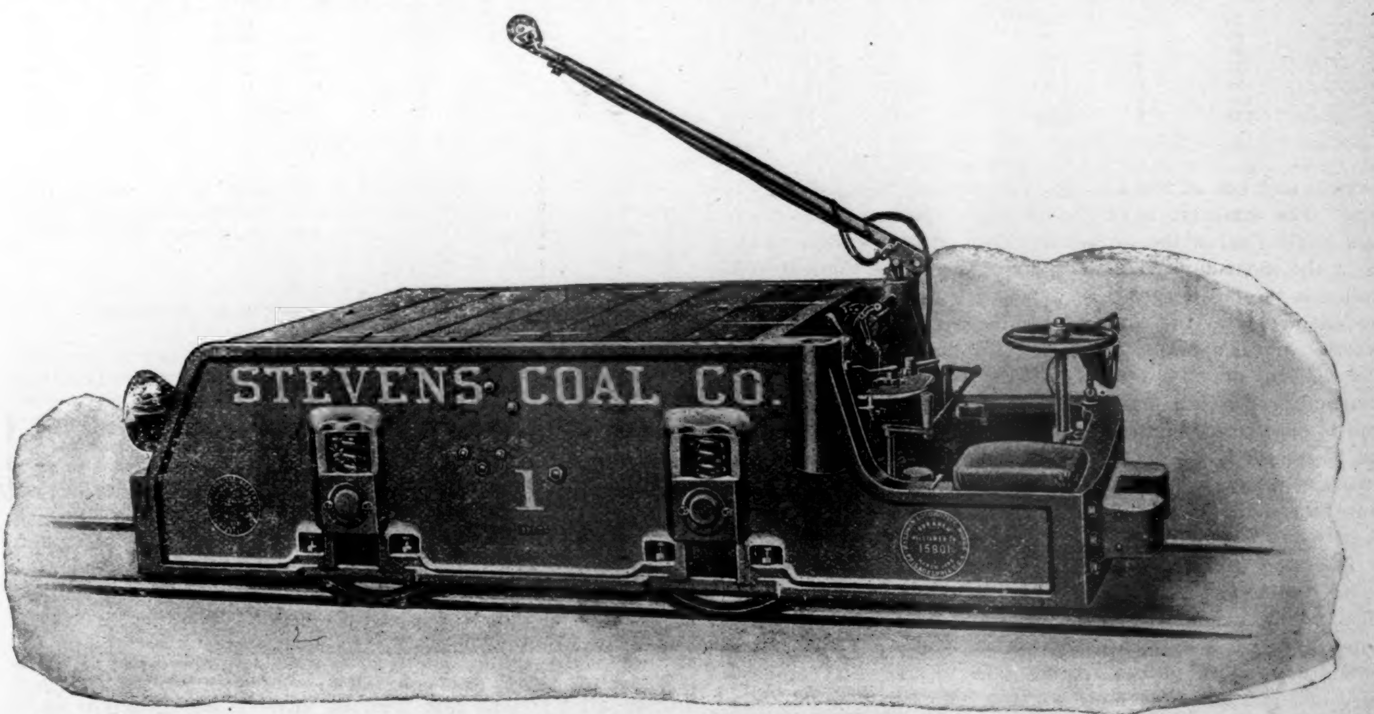
The compactness of the electric locomotive makes it perfectly adaptable to low and narrow entries; and, by reason of the absence of moving parts exposed to external injury, mechanism of the simplest possible character, and running parts readily accessible for replacement, the cost of maintenance is brought to a minimum.

The power for operating electric mine locomotives may conveniently be furnished from the same electric, generating plant which supplies current for lighting and other mining work, and the same wires may be made to convey the current for all purposes, thus making a simple system of distribution and reducing the attendance to the minimum.

The extended experience of the Baldwin Locomotive Works in the manufacture of steam and compressed air mining locomotives assures careful design of the mechanical features of the locomotives, while the well-known excellence of the electric railway apparatus of the Westinghouse Electric & Manufacturing Company guarantees that the especially designed motors for these locomotives embody the latest improvements in electric practice.

In designing a series of electric locomotives the range of practical requirements has been considered, and the table of sizes and powers given is intended to embrace apparatus covering all usual needs. It has been thought expedient to exclude abnormal specifications, as, for instance, gauges of track so narrow as to make the locomotive a mere toy, or locomotives of great power on narrow gauges, thus necessitating cramping the design of the motors or rating them above a safe working limit.

The general design is shown in the engraving. The locomotive frame consists of heavy cast-iron side and end pieces securely bolted together and kept square by machined joints and shoulders accurately fitted. These frame pieces are planed at top, bottom and ends, to insure perfect accuracy in fitting up and interchangeability of parts. The pedestal caps are forgings made to templet, and accurately fitted, so as to relieve the frame from breaking strains in case of severe shocks. The frame is placed outside of the wheels, thus allowing all possible space between the wheel hubs to admit the greatest practicable width of motor. This feature is of much importance in obtaining the maximum power on narrow track gauges. Furthermore, this construction permits of ready accessibility to the journal boxes, and protects all moving parts in case of derailment. Heavy planking with hinged doors is laid on the top frames, thoroughly protecting all electrical parts, but permitting access to them for inspection. End



Baldwin-Westinghouse Electric Mine Locomotive.

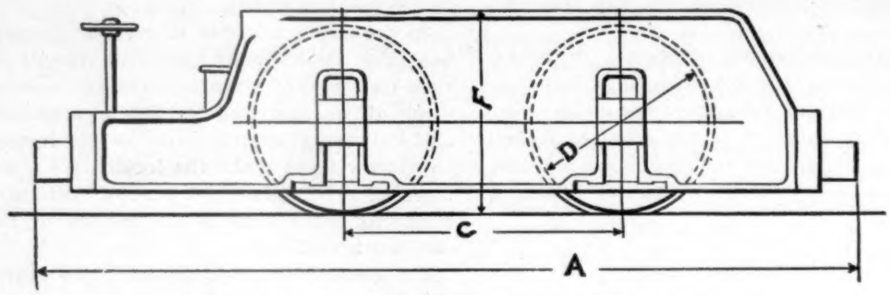
bumpers and coupling hooks are provided in conformity with requirements.

The journal boxes are of ample dimensions and have bronze bearings with oil cellars for sponging, as in steam locomotive practice. The brake apparatus, which is fitted to all wheels, is of simple design and of sufficient power to utilize the track adhesion due to the weight of the locomotive. The operating platform is placed at one end, and is compactly and conveniently arranged so that the motorman has all levers within easy reach without leaving the seat. The entire machine, with electrical apparatus, is supported on the journal boxes by helical springs, which prevent destructive pounding on the track and relieve the machinery from shock. The locomotive is driven by two spring supported motors, one geared to each axle by single reduction gearing running in oil lubrication in tight cases. These motors are designed especially for mining service and are of the four-pole, steel-clad, inclosed railway type. The armature is of the iron clad type, the coils being held in slots below the surface and secured from displacement, as in the most approved railway practice. The current controller is the latest rheostatic type, with magnetic blowout to prevent arcing at the contacts. It is provided with six speed changes, and is operated by handles for starting and reversing. The rheostat or "diverter" is of a non-combustible type, very compactly set up, and has large carrying capacity. The trolley pole is specially designed for this service; is reversible, and can be placed in a socket in either side of the frame, and automatically adjusts itself to varying heights of trolley wire. It is thoroughly insulated to prevent shocks to the operator when being handled, and the current connections are made by insulated cable.

The locomotive is provided with all necessary minor electrical fittings, such as fuses, lightning arrester and main switch and two electric headlights.

All sizes of locomotives are designed to run at a standard speed of eight miles per hour when developing their full load tractive effort. With light trains, requiring less than full load upon the motors, the speed may be increased. When starting, the train is brought gradually up to full speed by means of a controller. All of these locomotives are rated conservatively, and will develop the net draw-bar pull, shown in the table, under ordinary running conditions. The table gives standard sizes of mining locomotives, with their performance, weight and minimum dimensions. The draw-bar pull has been figured at full load and standard speed for the locomotives handling trains on a straight level track, and also on the limiting grades pertaining to ordinary mining practice, the adhesion of the locomotive being that found with fairly good condition of track and rail. Curves offer considerable additional resistance to the movement of locomotive and cars, and must be taken in account if of short radius, especially when they occur on grades. With track in fair condition curve resistance may be taken at one pound per ton of train weight per each one degree of curvature.

For average favorable mining conditions the friction may be taken at 30 pounds per net ton weight of loaded cars, but it may frequently amount to 40 pounds per ton, or more where conditions are unfavorable, and this latter figure should be taken in making calculations. To find, therefore, the number of tons (2,000 pounds) of train which can be hauled by a given locomotive: take from table the number of pounds drawbar pull which will be exerted by the locomotive on the limiting grade in the mine, and divide this figure by the train resistance in pounds per ton on the grade; the quotient will be the weight of train hauled. The train resistance per ton is found by multilpying the per cent. of grade by 20 pounds and adding 40 pounds friction to the result. For example: a class 4 2-10C locomotive on a 2 per cent. grade exerts 780 pounds drawbar pull; train resistance per ton is $20 \times 2 + 40 = 80$ pounds. Then $780 \div 80 = 9.75$ tons train (cars and lading) hauled.



Performance and Limiting Dimensions of Mining Locomotives.

Class.	Total Horse Power.	Speed M. P. H.	Full Load Draw-Bar Pull in Pounds. Level.	1 p. c. Grade.	2 p. c. Grade.	3 p. c. Grade.	4 p. c. Grade.	Minimum Track Gauge.	Wheel base C.	Diam. of Wheel D.	Width.	Length A.	Height F.	Weight.
								In.	In.	In.	In.	Ft. In.	In.	
$4\frac{2}{10}$C..........	20	8	900	840	780	720	660	24	44	24	41	10 4	33	7,000
$4\frac{2}{10}$C..........	20	8	900	840	780	720	660	30	44	28	47½	10 4	33	7,000
$4\frac{2}{15}$C..........	30	8	1,250	1.170	1,090	1 010	930	30	44	28	47½	10 4	33	8,500
$4\frac{2}{25}$C	50	8	2,100	1,980	1,860	1,740	1,620	30	44	30	48	10 4	33	12,000
$4\frac{2}{35}$C...	70	8	2 900	2 730	2.563	2 390	2,120	36	48	30	53	11 6	34	17,000
$4\frac{2}{50}$C	100	8	4.300	4,060	3,820	3,570	3.340	36	48	30	53	12 0	36	24,000
$4\frac{2}{75}$C..........	150	8	6,500	6,160	5,820	5,480	5,140	56½	60	36	74	13 6	42	34,000

EXPERIENCE WITH THE METRIC SYSTEM.

Reports of satisfactory experience with the metric system by manufacturers are interesting on account of their bearing upon the question of the difficulty in introducing the measures into shop work. The following is the expression of opinion of Captain Sankey, of Messrs. Willans & Robinson, manufacturers of the well-known Willans engine, contained in a paper read some time ago before the Institution of Civil Engineers (England). The subject is before the American Railway Association, and we shall soon print an article showing how the change to the metric system has been brought about in other countries. Captain Sankey said:

"No difficulty has been experienced in getting draftsmen to use the new measures. No serious mistakes have been traceable to the change, and very few minor ones. The draftsmen are practically unanimous in favor of metric measures, finding it easier to design, to check and to read millimeter drawings. Taking all fractions into account, little more than half the number of figures formerly used are now required to express a dimension. No mistakes have been made in marking off work to millimeters. The men preferred the old system at first, the new figures conveying little idea of size, but they are now much in favor of the millimeter, and find drawings so figured easier to read. The shop where the difficulties of the change would be most felt is that in which the tools and gauges are made; the foreman says that it was a little awkward at the outset—for about two days. In the works manager's opinion the metric system would prove even more advantageous in shops where measurements are taken from the rule than where gauges are used. He considers it easier to teach men the use of the rule with the metric than with English measures."

THE DIESEL HEAT ENGINE.

This comparatively new gas engine is much better known in Europe than in this country, but it is now being brought to attention and is creating a great deal of interest here. The Diesel engine uses petroleum, but it may use gas when necessary. It is the result of years of investigation and experiment by Mr. Rudolph Diesel, a German engineer of note, and some of the claims made for it are given below. There has been much difficulty in the ignition of charges of gas in these engines, and Mr. Diesel has dispensed with the spark or igniting tube and secures the ignition by means of the compression itself. Pure air is compressed to a high degree and then the fuel is introduced into the cylinder and it burns steadily during the stroke of the piston at practically constant temperature.

In the best triple-expansion steam engine over 1,000 horsepower as developed up to the present day, says Mr. Diesel, only 12 or 13 per cent. of the heat energy contained in the fuel is converted into available work, less than 10 per cent. being developed from smaller sized compound engines, 5 per cent. from small condensing engines, and even less in ordinary units not very carefully handled. The losses occur at several points. In the first place, the efficiency of the boiler is below 80 per cent., generally about 75. The theory of the steam engine shows that only a part of the energy of the steam can be converted into work even in a perfect machine operating between given steam pressures. This ratio may be 30 per cent. in a good engine, but no engine ever indicates much more than one-half of this, and finally there are losses between the indicated power and the brake power.

In his experimental work in attempting to design a more simple and economical engine in which the combustion is effected within the working cylinder, Mr. Diesel set forth several conditions necessary of fulfillment. The first of these was that the temperature of combustion must be generated not by the burning of the fuel, but before and independent of it, by mechanical compression. A second condition was that the fuel must be introduced gradually into this compressed air and in such a manner that the heat generated by gradual combustion shall give to the indicator card an admission line similar to that of the steam engine card, the point of cut off being imitated by the stopping of the fuel supply, the burnt gases then expanding adiabatically to the point of release, fresh air being compressed again up to the temperature of ignition for the introduction of the new charge. It is obvious that this is virtually a Carnot cycle, but it is necessary to deviate from a perfect cycle by expelling the expanded charge and taking in a new supply of air for compression, instead of isothermally giving heat to a continuously used charge of air from the walls of the receptacle at a high pressure, expanding it adiabatically, taking the waste heat isothermally from it at the lower pressure, and finally compressing it adiabatically to the temperature of the source of supply. Mr. Diesel also claimed that combustion should be carried on with a considerable surplus of air, the amount of which can be determined theoretically, instead of with as little surplus as possible.

In such an engine there are great possible advantages of superiority over the steam engine. No steam boiler is used; there is, therefore, no loss of heat in the flue gases or by boiler radiation, nor steam pipe condensation. The maximum available theoretical efficiency for such a motor is greater than that of the steam engine, owing to the possibility of using higher pressures, and consequently a higher range of temperature. This theoretical efficiency varies from 50 to 75 per cent. There is no cylinder condensation, and several other sources of loss are abolished. The mechanical efficiency is, however, likely to be a little lower than that of the steam engine, owing to the high compression necessary and consequent transmission and retransmission of energy between the piston and the fly wheel.

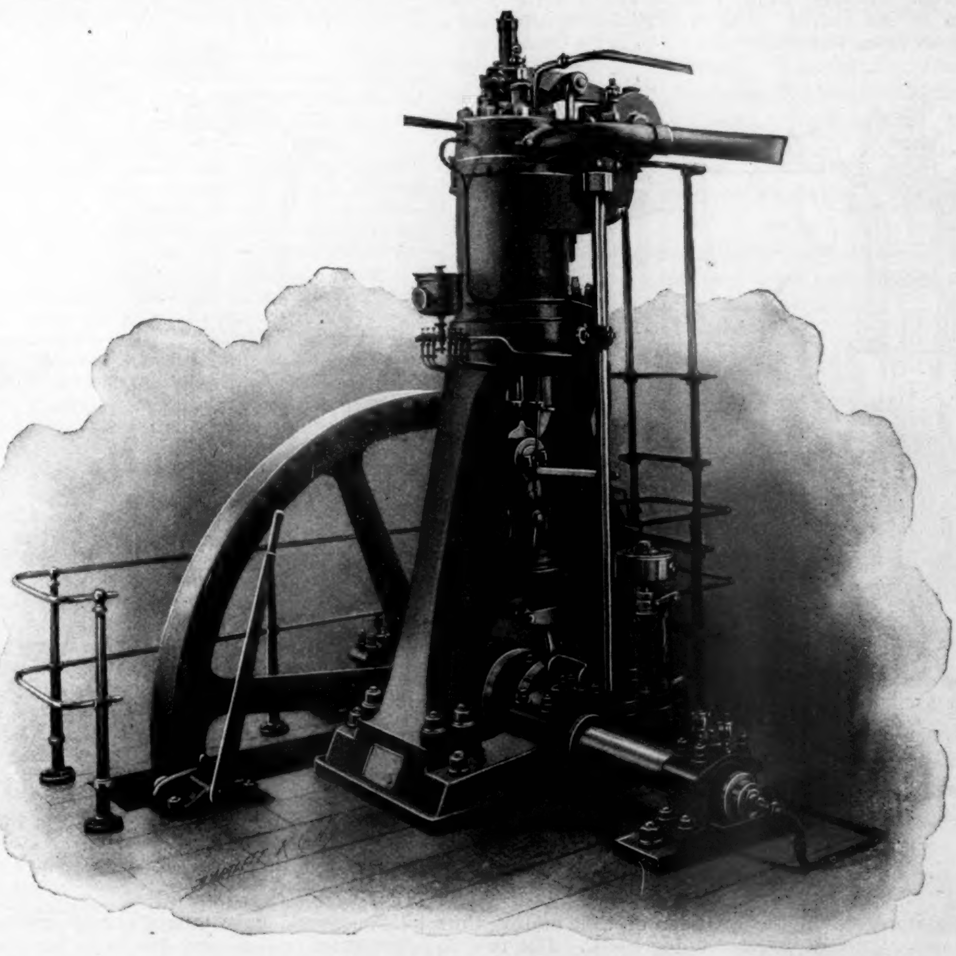


Fig. 1.—A 20-Horse-Power Diesel Motor.

The experimental engines so far constructed have been of the single-cylinder, four-cycle, single-acting, vertical shape, one of which of 20 horse power was tested with petroleum in the early part of 1897. This engine is provided with a ring piston and separate cross head, water-jacketed and provided with poppet valves operated by cams for admission and exhaust. A small pump is attached which keeps an auxiliary vessel filled with air compressed to a higher pressure than that obtained in the cylinder. This serves to inject the fuel, and also to start the engine.

With an engine of 20 horse power working with refined liquid petroleum, the maximum available theoretical efficiency was

about 50 per cent. and the actual ratio of indicated energy to the total energy of the fuel was about 35 to 40 per cent., showing an indicated efficiency of the engine as such of 70 to 80 per cent. The mechanical losses of this engine varied between 25 and 30 per cent. on high loads, giving over 26 per cent. of the total heat of the fuel as available energy at the shaft. With reduced loads the mechanical efficiency, of course, falls off, but the thermal efficiency, owing to the greater expansion, increases, thereby counterbalancing to a large extent the other and rendering the consumption of fuel per horse power low at all but the lightest loads. Owing to the high pressure employed in this engine also the cylinder dimensions are from 30 to 50 per cent. less than those of gas engines of the explosion type.

The governing of the speed is also as simple and easy as that of the steam engine. The exhaust gases are noticeably invisible and nearly odorless during ordinary running, owing to the perfect combustion, which also prevents fouling of the interior of the engine.

Fig. 1 shows a general view of a 20 horse power motor. Figs. 2 and 3 are cross sections, while Figs. 4 and 5 show a side view and plan of the valves. The description of the operation of this motor is as follows:

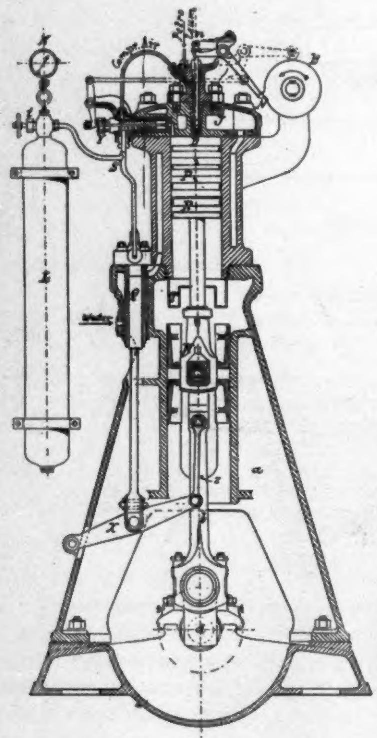


Fig. 2.

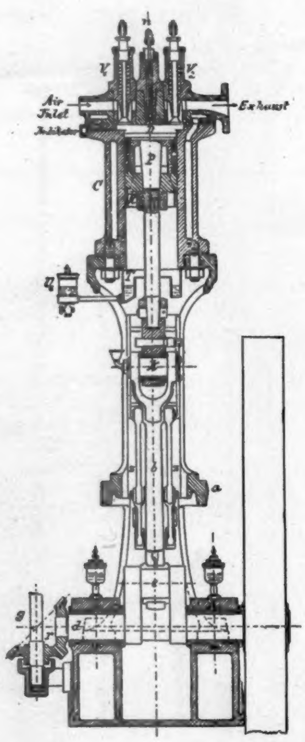


Fig. 3.

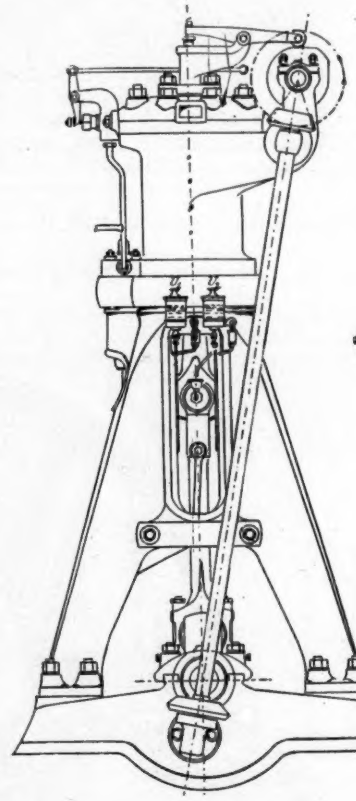


Fig. 4.

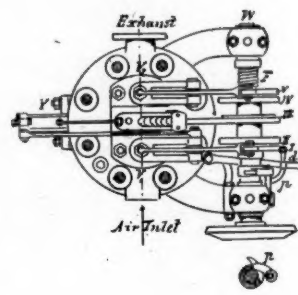


Fig. 5.

The Diesel Motor.

Pure air is compressed in the cylinder of this motor, thus generating a temperature of about 600 degrees C. The fuel to be used, such as gas, petroleum or powdered coal, is thereafter injected into the compressed air, where it is gradually and compl tely burned up at a much lower temperature than ever before accomplished. During combustion and during the succeeding expansion, it is entirely turned into work. The injection and combustion of the fuel takes place as the piston in the cylinder begins its return stroke. It ceases when it has reached about one-eighth or one-sixth of its way back, and it is so regulated that the increase in the temperature created by the compression of the air and subsequent combustion of the fuel is reduced by cooling off due to the work done during the succeeding expansion. Thus, practically there is no increase in sensible heat, since the heat caused by the combustion of the fuel is immediately turned into power and the motive power thus gained is only reduced by the small amount required for the compression of the air.

The small air pump Q, driven by connecting rod Z and lever X, keeps the vessel L filled with compressed air under a higher pressure than the highest compression attained in the cylinder, and is a new detail. By means of the pipe connection S the same excess of pressure is connected with the interior of the injection valve D. In it the petroleum is collected during the intervals in the four-cycle period between the combustion periods. This petroleum is introduced by a little pump, not shown in the figure. By opening the valve stem n, the fuel is by its high pressure caused to flow through the nozzle opening D to the combustion chamber of the engine, thus creating the combustion period, wherein the form and length of the combustion line can be altered, according to the performance of work, partly by changing the regulation of the fuel supply, partly by changing the excess of pressure in the vessel L, and finally by performing the injection at different points on the compression line.

The Diesel motor has been patented in all countries where patents are granted for inventions, and the rights for the United States and Canada have been acquired by a company, since incorporated under the laws of New York State, as the "Diesel Motor Company of America," with offices at 11 Broadway, New York.

EDUCATION OF THE APPRENTICE BOY.*

It is my conviction that the question of a scientific education is the most important part of our work. I will confine myself to that aspect of the subject. I am particularly interested in it, because I have taught the apprentice boy in science schools for many years, and my experience of the benefits resulting therefrom have been most satisfactory, both to the pupil and the railroad company.

It is a long time since I taught in those schools, but I recall the names of many of my pupils, some of whom never got beyond the work bench, but others who were talented have risen to high positions entirely through the knowledge acquired in those evening classes and the stimulus to reading and study which they naturally obtained through attending such schools. My experience, therefore, has altogether been in favor of educating our boys, not expecting that they will all attain responsible positions, but because even those who are dull will become better workmen, and the few who possess real ability will be separated from the ordinary mechanic and given an opportunity to rise above their surroundings and do better work in the world. If only for the sake of these few and for the good work which they will do in our profession and for our country, we ought to put forth every effort to make it easier to obtain a scientific education, and by largely increasing the number of schools make it more universal than at present.

I believe, therefore, that the importance of the question ot educating our apprentices cannot be overrated. It is a large subject and one of which a broad view should be taken. It is of national importance, the prosperity of our nation largely

*A letter from Mr. G. R. Joughins, Superintendent Motive Power, Intercolonial Railway of Canada, to a committee of the Master Mechanics' Association June, 1898.

depends upon it, because educated workmen are the backbone of a manufacturing country, such as ours. I am, therefore, deeply convinced that we ought to do all that is possible to impress upon others the great value of the work and induce them to give a helping hand to push it along.

It appears to me that as the Master Mechanics' Association is a national organization, it has an excellent opportunity to do good work. It can make its influence felt more extensively than any other body; it can recommend courses of teaching and obtain uniform results throughout the United States which no Federal authority, State college or university can do.

I do not agree with those members of the association who suggest that each apprentice should pay the full cost of instruction and that he should depend on his own manly efforts for an education. That principle is not applied to the education of anyone else, no matter what school, college or university he may attend, or what profession he may adopt. I believe it to be absolutely necessary to assist apprentices, and to assist them very substantially, both in school fees and in books. Various ways can be taken to raise money to help them, without making it a serious burden upon the railroad companies; it is done at the present time in some places, and could be done in all.

With enough money it is, in most places, easy to obtain a teacher; and in those places which are too small to support one the correspondence school could be used, but the necessity of giving assistance to the apprentices, in whatever way the education may be given, will always remain.

Having persuaded our members and the roads they represent to raise the funds necessary, the Association ought to map out a plan of education, naming the subjects in which examinations will be held and giving a list of the text-books, thus insuring uniform teaching. Then at the end of the session examinations should be held at the different schools, using the same examination papers, which could be prepared by some of our college friends, who so kindly offered to help, and which each school could order at cost price from the Secretary of the Master Mechanics' Association in sufficient quantities to suit. In this way a system of certificates of acquirements could be issued on a uniform standard, and which would prove of incalculable value both to the employer and employee.

Intimately related to the school question is the establishment of a technical library, which, no matter how small the beginning, could be gradually built up.

The Association should also find out what scholarships for mechanics, mathematics, etc., are given in each State or college for which our apprentices might compete, and publish them, special stress being laid upon the existing Master Mechanics' scholarship at Stevens Institute.

If the proposed plan should meet the approval of the committee, and nothing better be offered, I have no doubt but that it could be carried out. The first step toward the desired end would probably be to issue a circular to all members of the Association, giving an outline of the work which ought to be done, and of the possibilities in the direction of a better education for our apprentices; we would then ask what educational facilities are already afforded in each shop or town, including the Y. M. C. A. courses; also details as to what deficiences experienced, books used, cost of courses, and what assistance or encouragement is given by the railroad company or officials. After receiving and digesting the answers—which should be returned promptly—to these questions, we might be able to issue a circular pointing out the different ways in which funds can be raised, pointing out the importance of the subject, and asking each member or each railroad company what they would be willing to do toward the desired end.

The proposed science schools would not, of course, be confined exclusively to locomotive railroad apprentices. Apprentices from other shops who wished to join should be heartily welcomed on an equitable financial basis. Other organizations might wish to join in the plan of education, and should be encouraged to do so, but in the meantime the Master Mechanics' Association should go forward in the good work, and we, as its committees, should find out what ought to be done, what the railroad companies are willing to do, and make the best recommendations within our power to further the highest interests of the apprentice, which no doubt lie in the direction of a scientific education side by side with careful training in the workshop.

THE NEW BATTLESHIPS.

The Navy Department has issued advertisements for bids for the three new battleships authorized by the recent appropriation, and these will be opened September 1. The ships will be required to be completed within 33 months after the contracts are signed, and inducements will be offered for completion in a shorter time than this. Three years is the shortest time that has been specified heretofore. The new ships will combine what are considered to be the best features of the "Oregon," "Indiana" and "Iowa," all of which have proved their value and efficiency.

The new ships will be similar to the "Illinois," "Alabama" and "Wisconsin," now building. The "Iron Age" states that the Secretary of the Navy has christened 35 war vessels authorized by the Naval Appropriation bill. One of the battleships is to be called the "Maine," as provided for by act of Congress, while the other two will be known as the "Ohio" and "Missouri." Four protected monitors are to be called the "Arkansas," "Connecticut," "Florida" and "Wyoming." The first of the torpedo boats has been named the "Bagley," after the young ensign who was killed on the deck of the "Winslow" off Cardenas. Other torpedo boats will be known as the "Barney," "Biddle," "Blakely," "De Long," "Nicholson," "O'Brien," "Shubrick," "Stockton," "Thornton," "Tingey" and "Wilkes," all well known naval heroes. The 16 torpedo boat destroyers are named after naval officers of even greater renown, including "Bainbridge," "Barry," "Chauncey," "Dale," "Decatur," "Hopkins," "Hull," "Lawrence," "MacDonough," "Paul Jones," "Perry," "Preble," "Stewart," "Truxton," "Whipple" and "Worden."

SELLERS' FEED WATER STRAINER FOR LOCOMOTIVES.

A simple, compact, durable and easily accessible strainer for attachment to the feed hose connections between locomotives and tenders has just been introduced by William Sellers &

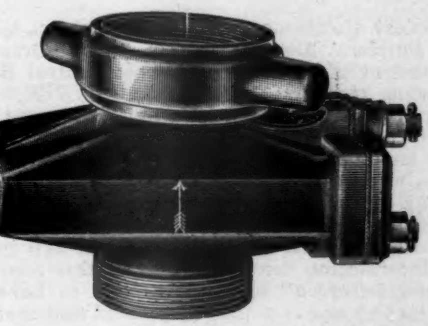


Fig. 1.—Sellers' Feed Water Strainer Ready for Use.

Company of Philadelphia. The whole device is so short in the body as to permit its insertion in the hose connection without any changes in the length of the hose, and the strainer plate, which is flat and of thick copper, provides so many one-six-

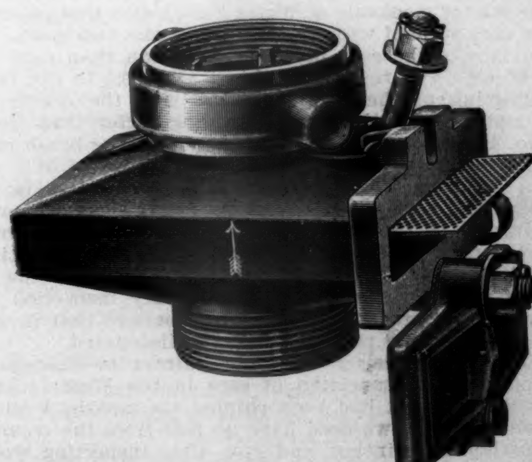


Fig. 2.—Strainer Opened for Cleaning.

teenth inch straining holes that half of them may be clogged without restricting the supply of water that the hose will carry. This plate is 5 by 7½ inches in size, and may be removed from the opening at the bottom of the casing, which is

made large enough to permit of cleaning the interior of the casing easily. The casing is strong and heavy, and the attachments of the covering plate are conveniently loosened for opening, as may be seen in the engravings. One of the fastenings is a fixed stud and the other a swinging bolt, both being attached to the casing to guard against loss when the cover is opened. It will be noticed that the only removable part is the strainer itself and its gasket, everything else being permanently attached to the casing. The hose attachments are those in general use, and the design was carried out in every particular with a view to avoiding the annoyances often caused by defective appliances of this kind. In service it has been very satisfactory.

CAR LIGHTING FROM THE AXLE.

The National Electric Car Lighting Co., Mr. Max E. Schmidt, President, equipped a number of cars on the Atchison, Topeka & Santa Fe Railway with its system of lighting by electricity from the axle last year, and the service has been so satisfactory as to result in an increase in the equipment. It is stated that ten additional cars will be lighted in this way at once, but we believe that more than this number will be fitted with the apparatus. It seems likely to come into general use on this road. The officials seem to be highly pleased with the light and also with the apparatus. Mr. Depew's private car, No. 100, on the Vanderbilt lines, has been lighted with this system for a number of months, and the enjoyment which he takes in fast running has given the system a severe test, which it has met satisfactorily. The lighting company is sparing no trouble or expense to improve its system, and we are informed that a test is now being made with a newly developed system of transmission of power from the axle, which does not require a belt between the axle pulley and the dynamo. The new plan seems to be very promising

PAINTING CARS BY COMPRESSED AIR.

In a topical discussion on the above subject before the Master Car Builders' Association, Mr. F. W. Brazier, Assistant Superintendent of Machinery, Illinois Central Railroad, made the following remarks:

"Paint Applied to Freight Cars by Compressed Air," as compared with paint applied by the brush, is a question which our company has taken great interest in. We are repainting about 400 cars a week with compressed air. We are positive that we are getting better results, a saving in labor, and our cars are painted more thoroughly than with a brush. We have cars that have been painted about two years, and in order to get reliable information for the benefit of this association I sent out inquiry letters all over our system to have our foremen painters inspect any cars that they could find that were painted with air. We found most of the old school painters opposed to the air system when we inaugurated it. Our painters report as follows:

"'After making close observation of several cars done by air and by brush, I find but very little difference in them, and, if any, it is in favor of the cars done with air.'

"'Cars painted by air look equally as well and show no more sign of giving way than those done by brush; therefore think air best on account of cheapness in applying.'

"Our master mechanic at Water Valley says that on examination of cars painted with air within the past two years: 'I find the surface of the cars in better condition than cars painted with brush. The reason for this I attribute to the fact that the spraying of the paint with air fills the cracks of the wood and between the joints of siding better than the brush will do, as men are apt to be careless with the brush in painting and overlook joints in beading.'

"Another says: 'The process is of much value in the expeditious and economical covering of that class of equipment. The driving of the pigment against a surface of lumber by air pressure is an advantage in the fact that all portions are covered, beading, cracks or any such openings, due to the wear of a car in normal condition. My inspection of cars painted by air process has led me to believe that in point of durability the hand process is largely discounted.'

"The following letter from our painter in Chicago shows his opinion and inspection of cars in the West: 'After inspecting work that had been painted six months I felt pretty well satisfied that we need have no fear from the results from this method of painting, and now after inspecting work that has been out nearly two years I feel perfectly satisfied that work done by compressed air will surely wear as well if not better than brush work. There is one particular advantage that paint applied by air has over brush work, and that is that it reaches every possible opening, being driven into the open grain of the wood farther, into all cracks, beads and many places where it is impossible to get with the brush, thereby more effectually sealing the wood, iron or whatever you may be painting to all exposure. Air applied paint in time becomes very hard, and although it becomes hard it does not get brittle, but seems to retain its life, and does not seem to chalk and perish like ordinary brush-applied oil paint.'

"In conclusion I wish to state that I have personally inspected hundreds of cars done by compressed air, and I feel safe in saying that we got far better results from air as far as wearing qualities are concerned. I think that air is desirable from the fact that we get our cars painted with a great saving in labor."

LUMBER SPECIFICATIONS FOR FREIGHT CARS.

A portion of the discussion by Mr. Pulaski Leeds on the above subject before the Master Car Builders' Association was printed on page 220 of our July issue, and we now give other portions of his remarks on specifications as follows:

Having been delegated to make some suggestions relative to the subject of lumber specifications for freight cars, I note that the committee indicates that this should be confined to dimensions, but, in my opinion, it would be fully as essential that the quality should be specified first, and have taken the liberty to outline what, in my opinion, would enable us to obtain a class of lumber suitable for our needs, without working a hardship upon the mill men or increasing the price on account of unnecessary requirements. With such specifications, which give the poorest grade that would be accepted, there should not be any question between mill men and inspectors.

Rules for Inspection of Lumber for Mechanical Department.—All lumber must be manufactured from sound, growing timber, true to dimensions, straight grained, and free from bark edge, splits, shakes, rot, worm holes, loose or rotten knots, or sound knots above the dimensions given, or so located as to materially impair the strength or durability of the piece.

In framing material, where the cross section is 4 by 8 inches and upward, sound knots 1½ inch in diameter will be allowed if not less than 3 feet apart and not less than one-fourth the width of the piece from the edge. Pieces which contain the heart center must be cut so the center of heart will not be less than 2 ins. from either side or edge. Pieces which do not contain the center heart, as above, shall not be sawed less than 1 inch on side or edge, or 2 inches on corner from center. Bright sap will be allowed to the extent of ½ inch, measured at its least depth, provided that when on the side of a piece the poorest edge shall show three-quarters of thickness sound heart; when sap is on one corner of a piece it must show two-thirds the depth and one-half the thickness of good heart timber; when on two corners it must show sound heart three-quarters of width and depth, respectively, on poorest edge and sap side; when it shows on four corners the edges must show three-quarters, and the sides seven-eighths of heart timber.

In smaller dimensions the knots and all other defects must decrease in proportion.

All main sills, side plates, side boards, running boards, ridgepoles, purlines and pine flooring, when of long leaf yellow pine, must be cut in the States of Georgia, Florida, Mississippi or Alabama.

Side boards, flooring, running boards, ridgepoles, purlines, etc., must have one entire heart face, and not less than three-quarters the width on opposite side, with one-half the thickness on both edges heart.

Siding and lining for freight cars should be ordered in 1 by 4-inch strips, or proper widths to make them, and such strips should have one clear heart face; bright sap on opposite side. one and two sound knots ¾ inch diameter to each strip of 8 feet in length will be accepted. When ordered in wide boards the inspection will be in accordance with this. This timber must be free from pitch streaks and pockets.

For Winslow roofing in strips of 6 inches wide, bright sap to the extent of one-third the width, and two sound knots ¾ inch diameter in a piece 5 feet long will be admissible, if not near the edge.

For double board roofing, one face must be clear heart and free from knots, opposite side and edges not less than one-half heart.

Stock boards 10 inches and over will be accepted with perfectly sound knots of 2 inches diameter, if fairly intergrown to prevent falling out, to the extent of three in a length of 12 feet, if not located near the edge. Sap should not exceed one-third width of board on either side.

Common boards can be all bright sap if clear from knots, or one-half sap with sound knots, as in stock boards.

On orders for oak, nothing but white or burr oak will be accepted.

Blue sap will not be accepted in anything, but in common boards a slight stain will be admissible.

As these rules are descriptive of the poorest quality that will be accepted, it is expected that at least 75 per cent. of each shipment will be of superior quality.

LARGE LOCOMOTIVE BOILERS.

In discussing the importance of large capacity in locomotive boilers before the Master Mechanics' Association, Mr. M. N. Forney mode the following suggestive remarks:

This subject has been before the association a great many times, and it has been discussed under many different aspects. So far as my own observation and thought is concerned, my ideas may be summed up in the one brief statement that within the limit of weight and space to which you are necessarily confined in the locomotive you cannot make the boiler too big. D. K. Clark a good many years ago expressed the general proposition that the larger the heating surface the greater the economy, and the smaller the grate surface, provided you can burn enough fuel, the greater the economy. These propositions have sometimes led to a wrong deduction so far as the grate surface is concerned. People have drawn the inference that if a small grate surface is desirable a small firebox is desirable. While I think a reduction of the grate surface will often result in an economy of fuel, yet at the same time I would think it desirable to maintain a considerable volume within the firebox to give room for combustion to take place. The proportion of the grate to the quantity of fuel to be burned is a matter of much importance, and about which we have no accurate information. There is probably no direction in which so much economy can be effected as right here with proper and careful experiments. My experience has taught me this general fact, that the larger the locomotive boiler is the better results you can get—a good, reliable boiler is worth all the rest of the machinery you can put on a locomotive.

BODY BOLSTERS AND SIDE BEARINGS.

The views of Mr. A. E. Mitchell, superintendent of motive power of the Erie Railway, upon the importance of keeping trucks and car side bearings out of contact were printed on page 229 of our July issue, and the figures which he gives are interesting and specially valuable on account of the fact that they were prepared with the assistance of a dynamometer car to record the differences in power required when the side bearings were in contact and when they were clear of each other. Mr. Mitchell experimented with two trains of practically equal weight, one of the trains having 100 per cent of the side bearings clear of each other and the other having only 12 per cent in this desirable condition. It was found that the difference in drawbar pull was 7.6 per cent in favor of the first train, and the difference in fuel consumption was 8.3 per cent in favor of the clear side bearings. Mr. Mitchell says: "These figures show you the enormous saving which can be made if the cars are all center bearing."

This is no new discovery, but railroad men are certainly indebted to Mr. Mitchell for this painstaking method of ascertaining the standing of this question upon a basis of dollars and cents. It is a question of grave importance and should have immediate attention.

The discussions of the subject point to weakness in the construction of cars resulting in undue deflection of the body bolsters. This may be partly remedied by a better distribution of the loads in their transmission to the bolsters so that the center of these members will receive their proper proportion of weight, but even this will not answer unless stiff bolsters are provided. In talking the subject over with Mr. W. S. Calhoun, of the American Steel Foundry Company, it was made apparent that this company among others has forseen the difficulty with weak bolsters and has for a long time been preparing to meet it by introducing bolsters which will hold loads of large capacity cars without troublesome deflections. We shall have more to say about this type of cast steel bolster in connection with recent improvements on several railroads, but will take this opportunity to note that by making stiff bolsters in one piece a large number of small parts are avoided, and the result, with good designing, ought to be bolsters that will far outlive the cars themselves. For instance, there are no separate center plates in these bolsters, and even if the center bearings should wear down slightly it is a very simple matter to chip off the tops of the truck bolster side bearings to correspond with the wear, the result being to restore the relation between the side bearings to their original condition. There are now 50,000 trucks in use with these bolsters, every one of which is tested before leaving the works, and we are told that the record is absolutely clear of failures up to date.

The question of weight sometimes urged against cast steel bolsters is answered by these people with the statement that there is no bolster so light for the capacity of these. In tests made on truck bolsters intended for cars of 60,000 pounds capacity a load of 100,000 pounds has been given in a hydraulic testing machine with a deflection of only 0.18 inch and no permanent set.

PERSONALS.

Mr. Henry Haynes, of Brenham, Tex., has been appointed Receiver of the Texas Western Railroad.

Mr. M. S. Curley has been appointed Master Mechanic of the Illinois Central shops, at Water Valley, Miss.

Mr. T. S. Tutwiler has been appointed Chief Engineer of the Plant system, with headquarters at Savannah, Ga.

Mr. J. H. Hawthorn, Master Mechanic of the Chicago & Erie, has resigned to enter the service of the Lehigh Valley.

Mr. Joseph J. Slocum, of New York, has been appointed Receiver of the Poughkeepsie & Eastern in dissolution proceedings.

Mr. G. E. Hustis has been appointed General Superintendent of the West Shore Railroad, to succeed Mr. C. W. Bradley, resigned.

Mr. A. J. Fox, of Detroit, Mich., has been chosen President of the Manistique & Northwestern, to succeed Mr. A. Weston, deceased.

Mr. Edward D. Seitz has been appointed Purchasing Agent of the Louisville, Evansville & St. Louis in place of Mr. W. W. Wentz, resigned.

Mr. Thomas Green has been appointed Acting Chief Engineer of the Minneapolis, St. Paul & Sault Ste. Marie Railway, to succeed Mr. W. W. Rich, resigned.

Mr. T. W. Hansell has been appointed Superintendent of Machinery of the Astoria & Columbia River Railroad, with headquarters at Astoria, Ore.

Mr. George H. Holt has resigned as Vice-President of the Indiana, Illinois & Iowa, and Mr. Joy Morton has been chosen to succeed him, with office in Chicago.

Mr. William Cotter has been appointed Superintendent of the western division of the Grand Trunk, with office at Detroit, to succeed Mr. A. B. Atwater, resigned.

John M. Marstella, Master Mechanic of the Baltimore & Ohio shops at Martinsburg, W. Va., died in that city June 25 from a stroke of paralysis. He was 57 years old.

Mr. F. O. Miller, Traveling Engineer of the Cincinnati, Hamton & Dayton, at Ashland, Ky., has resigned to accept the position of Traveling Engineer of the Baldwin Locomotive Works.

Mr. George F. Evans, General Manager of the Canada works of the Westinghouse Air Brake Company, has sailed for Russia to establish a plant for making air brakes in St. Petersburg.

Mr. T. P. Shonts, who has been General Manager of the Indiana, Illinois & Iowa Railroad for twelve years, has been elected President of that road, to succeed Mr. F. M. Drake, resigned.

Mr. J. W. Campbell has resigned as General Manager of the Eastern Ohio Railway, and the office has been abolished and its duties assumed by Mr. W. H. Stevens, General Superintendent.

Mr. C. E. Lamb, Master Mechanic of the Hannibal & St. Joseph, has been appointed Master Mechanic of the Kansas City, St. Joseph & Council Bluffs, with headquarters at St. Joseph, Mo.

Mr. S. G. Simpson, General Freight and Passenger Agent of the Puget Sound & Gray's Harbor, has been chosen President of that road, to succeed Mr. J. A. Campbell. Headquarters, Seattle, Wash.

Rear Admiral Daniel Ammen, U. S. N., retired, died July 11. He was the designer of the ram "Katahdin" and was well known also for his efforts to interest people in the construction of the Nicaragua Canal.

Mr. C. F. Winn, who has been Joint Foreman of the Denver & Rio Grande and the Rio Grande Southern at Durango, Col., has been appointed Master Mechanic of the El Paso & North Eastern Railway, at El Paso, Tex.

Mr. P. J. Nichols, who recently resigned as General Superintendent of the Pacific division of the Union Pacific, has accepted the position of Superintendent of the Omaha Bridge & Terminal Company, at Omaha, Neb.

Mr. N. D. Miller has been appointed Chief Engineer of the Great Northern Railway, to succeed Mr. J. F. Stevens, resigned. Mr. Miller was formerly Chief Engineer of this line, but resigned in 1895 to engage in other enterprises.

Mr. George W. Stevens, formerly Purchasing Agent and Superintendent of Car Service of the Cincinnati, New Orleans & Texas Pacific, has been appointed Purchasing Agent of the Mobile & Ohio Railroad, with headquarters at Mobile, Ala., to succeed Mr. R. H. Duesberry, resigned.

Mr. H. S. Rearden, formerly Superintendent of the Chicago, Peoria & St. Louis, which position he resigned January 1 last, has been appointed General Superintendent of the Detroit, Toledo & Milwaukee, with headquarters at Toledo, Ohio, to succeed Mr. N. K. Elliott, resigned.

Mr. W. H. Caniff, who recently resigned as General Manager of the Lake Shore & Michigan Southern to accept the Presidency of the New York, Chicago & St. Louis, was on June 30 presented with a handsome gold watch and chain and a diamond stud by the employees of the former road as a token of the high regard in which he is held by them.

Mr. C. D. Ives, of Cedar Rapids, Iowa, a son of C. J. Ives, president of the Burlington, Cedar Rapids & Northern Ry., has reported to the War Department in answer to a summons from Secretary Alger. He will be appointed Captain and Commissary of Subsistence, and will be placed in charge of shipping all provisions and other commissary supplies to the army in the field.

Mr. A. G. Wand has been appointed General Agent for North America of the London & North Western Railway (England), Caledonia Railroad (Scotland) and Great Southern & Western Railroad (Ireland) to succeed C. A. Baratttoni, deceased. Mr. Wand has been in the service of the London & North Western nearly twenty-five years, and was transferred to New York from the London office of the company when Mr. Barattoni was appointed in 1887.

Mr. Angus Brown, formerly Master Mechanic of the Northern Pacific at Livingston, has been appointed to succeed Mr. James MacNaughton as Superintendent of Motive Power of the Wisconsin Central lines. Mr. Brown is succeeded by Mr. W. S. Clarkson, formerly Master Mechanic of the Rocky Mountain Division of the Northern Pacific, and Mr. J. P. Barnes, General Foreman of the Brainerd shops of the same road, has been promoted to Mr. Clarkson's position.

A communication from Shanghai says that an American named Captain Watson W. Rich, late Chief Engineer of the "Soo" Railway, and well known in the Lake Superior country, has been appointed Consulting Engineer of the Chinese Railway Administration, with headquarters at Shanghai. Captain Rich will be in charge of all railways building in China, under the immediate direction of Sheng Taien, Director-General of Railways. This appointment is likely to prove of considerable benefit to American manufacturers of railway supplies and equipment.

Mr. D. M. Philbin, General Superintendent of the Duluth, Superior & Western, has been made second Vice-President of the Eastern Railway of Minnesota, owing to the purchase of the former road by the latter. Mr. Philbin was formerly for three years General Manager of the Duluth, Missabe & Northern, and has been General Superintendent of the Duluth, Superior & Western since April, 1896. From 1890 to April, 1893, he was Superintendent of the Duluth, South Shore & Atlantic, and in 1889 was Superintendent of the eastern division of the Fremont, Elkhorn & Missouri Valley.

Mr. William Voss, well known as a master car builder and mechanical engineer, has lately accepted the position of Superintendent with the Jackson & Sharp Company, car builders, of Wilmington, Del. Mr. Voss is a graduate of a German technical school, and began on the Burlington, Cedar Rapids & Northern Railway, where he rose from the ranks to the head of the car department, and was afterward made Assistant Master Mechanic. He has held the position of Assistant Superintendent for Barney & Smith, of Dayton, O. Mr. Voss is well known to all railroad mechanical men through his book on "Railway Car Construction," which is the best book ever written on the subject.

Henry Flad, the well known civil engineer of St. Louis, Mo., died suddenly at Pittsburg, Pa., June 20. He was born in Bavaria, in July, 1824, and came to America in 1848. In 1854 he was appointed Resident Engineer of the Iron Mountain Road in Missouri, and had charge of the construction of a portion of that line. He also made surveys for several other roads in Missouri, and from 1867 to 1874 was the Chief Assistant of Colonel Eads in the construction of the great St. Louis Bridge. In 1877 he was chosen President of the Board of Public Improvements of St. Louis, which office he held until 1890, when he resigned to become a member of the Mississippi River Commission. He was at one time President of the American Society of Civil Engineers.

Mr. S. R. Callaway, President of the New York Central & Hudson River Railroad, writes us that Mr. H. J. Hayden, Second Vice-President, will hereafter represent the New York Central & Hudson River Railroad and its allied lines on the Board of Managers of the Joint Traffic Association. Mr. H. Walter Webb having resigned owing to ill health, the office is abolished. Mr. J. M. Toucey was appointed assistant to the President and the office of General Manager was discontinued, but he retired from service as noted elsewhere. Mr. Nathan Guilford, General Freight Traffic Manager, will have general supervision of all freight traffic and Mr. George H. Daniels, General Passenger Agent, of all passenger traffic, reporting direct to the President. The General Superintendent, Chief Engineer, Superintendent of Motive Power and Rolling Stock and the Purchasing Agent will hereafter report to the President direct

HIGH STEAM PRESSURE VS. CAPACITY OF LOCOMOTIVES.

By William Forsyth.

Abstracts of the valuable report of the committee on "Efficiency of High Steam Pressure for Locomotives," presented at the recent convention of the Master Mechanics' Association, were printed on page 251 of our July issue, and we stated that one of the appendixes of the report, written by Mr. William Forsyth, Mechanical Engineer of the Chicago, Burlington & Quincy Railroad, entitled "Pressure vs. Capacity," would be given in full. This is the era of increased boiler power and the importance of increased capacity is now so clearly shown in records of heavy engines in service as to render Mr. Forsyth's presentation of the subject specially timely.

Pressure vs. Capacity.

It may be assumed that the efficiency of a locomotive may be increased either by increasing the pressure on the boiler or by increasing the size or capacity of the boiler. If the pressure is increased, the gain is to be found in the improved performance of the engines; if the pressures remain unchanged and the boiler is made larger its evaporative efficiency, when developing a given power, will be increased. Either an increase in pressure or an increase of capacity involves greater weight, and as the cost of a boiler of any given type will be approximately proportional to its weight, the whole question may be resolved into the following statement, namely: Shall any added weight which may be given the boiler of a locomotive be devoted to increasing its strength that a higher pressure may be carried, or to increasing its capacity that it may render its service while working at a correspondingly lower rate of power? The following paragraphs present some facts bearing on this question:

SHOWING CHANGE IN WEIGHT OF BOILER WITH STEAM PRESSURE.

Steam Pressure.	Weight of 60-inch Boiler.	Weight of 52-inch Boiler.
I.	II.	III.
140	...	21,035
150	33,121	......
180	35,253	......
210	38,513	......
240	39,035	......
250	......	25,775

Pressure and Weight of Boiler.—This table gives, in Column II., the weight of a 60-inch boiler suitable for a Mogul or ten-wheeled engine designed for different pressures varying from 150 to 240 pounds. The values given in this column are estimates supplied through the courtesy of the Baldwin Locomotive Works. Column III. of the same table gives weights of the boilers of the Purdue experimental locomotives, No. 1 and 2 respectively, which are in every way similar, excepting that one was designed for a pressure of 140 pounds and the other for a pressure of 250 pounds.

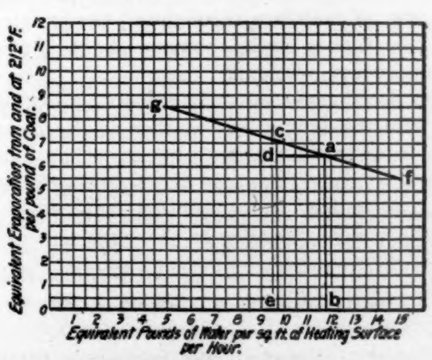


Fig. 4.—Reproduced from Report.

It will be seen that an increase in steam pressure from 150 to 240 pounds in a 60-inch boiler necessitates an increase in weight of 5,900 pounds, or 18 per cent., and that an increase in steam pressure from 140 to 250 pounds in a 52-inch boiler. necessitates an increase in weight of 4,700 pounds, or of 22 per cent. It will, therefore, be sufficiently accurate for our purpose to asume that a change of pressure from 150 pounds to 240 pounds, an increase of 90 pounds, will necessitate an increase in weight of boiler of about 20 per cent. The benefit to be derived from such an increase of pressure may be judged by reference to other portions of this report. We may next inquire as to the probable effect of converting the 20 per cent. increase in weight into increase in capacity.

Efficiency and Capacity.—The evaporative efficiency of a boiler depends on the rate of power to which the boiler is worked. The relation of efficiency and power, as defined by a large number of tests made upon the boiler of "Schenectady No. 1" at Purdue is shown by the accompanying diagram. It will be seen that when the power is such as will require 5 pounds of water to be evaporated per foot of heating surface per hour, 8½ pounds are evaporated for each pound of coal burned; but when 15 pounds of water must be evaporated per foot of heating surface per hour, only 5½ pounds are evaporated per pound of coal. Strictly speaking, the relationships disclosed by Fig. 4 apply only to the boiler from which they were derived, but as all locomotive boilers of usual form may be expected to give a curve of the same general character, that which is presented may be employed as the basis of the following general illustration. Thus, suppose that the demand for steam upon what may be called a "normal" boiler is such as to require the boiler to work at the point a on the curve of efficiency. If, now, the same demand for steam is supplied by a boiler whose heating surface is greater than that of the normal boiler, the larger boiler will work at some point, c, higher on the curve of efficiency; the increase in efficiency will be represented by the ratio of c d to a b. An inspection of the figure will show that the value of the ratio depends upon the length of the line d a and upon the location along the efficiency curve of the initial point a. That is, the increase in efficiency depends, first, on the amount of increase of heating surface, and, second, on the rate of evaporation of the assumed normal boiler.

Numerical values, based on the assumption that increase in capacity will be proportional to increase of weight, are given in the following table:

SAVING IN FUEL BY USING A BOILER WHOSE CAPACITY IS GREATER THAN AN ASSUMED NORMAL BOILER.

Pounds of water required to be evaporated per square foot of heating surface per hour in a normal boiler.	Percentage saving in fuel by using a boiler whose capacity is greater than the normal boiler, by 5, 10, 15 and 20 per cent., respectively.			
	5 per cent.	10 per cent.	15 per cent.	20 per cent.
I.	II.	III.	IV.	V.
5	0.8	1.5	2.2	2.9
6	1.0	1.9	2.8	3.7
7	1.2	2 3	3.4	4.5
8	1.5	2.9	4.1	5.3
9	1.8	3.4	4.8	6.1
10	2.0	3.9	5.5	7.1
11	2.3	4.5	6.4	8.2
12	2.7	5.1	7.4	9.4
13	3.0	5.7	8 4	10.7
14	3.4	6.4	9.4	12 0
15	3.8	7.4	10.6	13 6

This table shows that the saving which results from increasing the capacity of a boiler is most marked at high power. Thus, an increase of 20 per cent. in the size of a boiler increases the evaporative efficiency only 2.9 per cent. under a development of power which would be supplied by the normal boiler, by an evaporation of 5 pounds of water per foot of heating surface per hour, but increases to 13.6 per cent. when the power is increased threefold.

It is perhaps fair to presume that the heating surface, or better, the steam-making capacity, of a boiler of any given type may, within limits, be proportional to its weight. The improvements in efficiency recorded in Column XV. of Table II. are such as may be expected to result from such an increase of size as would produce a 20 per cent. increase in weight, the boiler pressure remaining the same.

The table referred to as No. II. gave the following figures from tests upon the laboratory locomotive, "Schenectady No. 1":

Speed in Miles per Hour.	Boiler Pressure by Gage.	Steam per H. P. Hour.
35.00	98.4	28.8
35.30	131.7	26.3
35.20	143.3	24.9

These values compared favorably with the possible gain in efficiency to be derived from an increase of pressure alone, and while the gain from increased pressure must for the present remain a matter of some speculation and doubt, that which is to be had through increased capacity is both certain and fixed.

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Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Special Notice.—*As the* AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL *is printed and ready for mailing on the last day of the month, correspondence, advertisements, etc., intended for insertion must be received not later than the 20th day of each month.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

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The question of stenciling the light weights of cars was taken up at the Convention of the Master Car Builders' Association, the increasing practice of loading locomotives on a tonnage basis being the reason for agitating the subject at this time. The matter has been considered by the Executive Committee of the association, and all car owners are requested to stencil these weights upon all cars and they are also asked to correct it when occasion requires, in order to facilitate economical operation. This is important, and railroad officers will at once see its effect in making it possible to give locomotives their proper loads. Other car owners will doubtless need some urging in order to bring them to view the matter in the light of a business item, from which they will benefit beyond comparison with the cost of the work. If private car owners do not act promptly the roads will save themselves trouble by doing the work, even at their own expense.

Reliable information with regard to the relative merits of different paints is very difficult to get and records of comparative tests are always subject to a great deal of criticism, because of the necessity for the existence of the "personal equation" in the comparisons ,and also because of the great difficulties of securing conditions that are fair to all concerned.

We print in this issue a report on a comparison recently made in New York City which while not above criticism in regard to the length of time of exposure has the important recommendation of disinterestedness which is not always present in such cases. A longer trial of the paints might change the relative positions of some of them in regard to rust preventing qualities, but we do not believe that longer trials would alter the position of the carbon paints at the head of the list. In such trials red lead appears at a disadvantage because no one appears to be financially interested in these paints to such an extent as to give them the same care that the other patented or special paints receive. If the tests quoted are not to be accepted as final, and we do not think they ought to be, they are valuable as a step in advance which indicates the desirability of following the work up to a satisfactory and conclusive finish. Probably the only way to accomplish this is to place the subject in the hands of a carefully selected committee of the American Society of Civil Engineers. The value of accurate knowledge of the commercial value of paint for protecting iron structures is so great as to necessitate further work in this direction and the opportunity for the best kind of information to be obtained under the severest conditions of service is at hand.

GOVERNMENT TIMBER TESTS.

The tests on timber conducted in 1897 by the United States Department of Agriculture, the conclusions from which are given elsewhere in this isue, are important in practical results, which throw light upon several hitherto disputed points.

They show how great a degree of uniformity may be expected in strength of timber and indicate that differences of less than 10 per cent. in testing conifers and 15 per cent. with hard woods are to be expected in timber of the same kind.

As regards the influence of the size of the specimens, it appears that a marked increase in strength was found only when the length of the specimen was shorter than its width or, in other words, when the piece was shorter than a cube. Another important result was to show that the value of full sized specimens for test had been greatly over-estimated and the conclusions further indicate that it is not necessary to bother with a coefficient in obtaining the strength of large timbers based upon tests of small specimens within the limits already stated. The report makes this statement confidently and the effect will be to greatly simplify timber tests.

The tests on distribution of moisture show a comparatively uniform distribution along the stick in timber dried in yards, while a difference of 2 per cent. of moisture was found in adjacent sections of kiln dried timber having an average of from 5 to 7 per cent. of moisture throughout, the ends of the sticks for about two inches back showing about 3 per cent. less moisture than other portions.

The report is commended to engineers and others who are concerned with the strength of timber as the most important addition to information on the subject. The value of these results directs attention anew to the desirability of furnishing means for continuing, to completion, the work of the department which is so valuable, so thorough and so practical.

THE NAVY AT SANTIAGO.

It is too early to draw all the important inferences with regard to warship construction from the recent destruction of the Spanish fleet off Santiago, but the report of the Board of Survey, after examining the condition of the four wrecked cruisers, points to several exceedingly important factors which, we are safe in saying, will exert a powerful influence on future designs. In addition to these, we shall briefly comment upon another feature of this fight which does not appear to be properly appreciated.

While the Spanish ships suffered severely from direct gun

fire, they suffered more from conflagration caused by the exploding of well placed shells, and this drove several of them ashore. Large amounts of wood in decks, partitions and furniture have already been deprecated, but after this example our Navy Department should see to it that they have a large amount of handsome woodwork from our own ships for sale at the close of the war.

With less woodwork there will be less danger from fire, and less damage if fire should break out, but there is every reason to guard the fire apparatus from damage from shots. At Santiago the fire mains of the "Maria Teresa" were placed above the protective deck and were broken by a shell before the fire broke out. The place for fire mains is behind armor, and it should not be necessary to wait for this tragedy in order to extablish what is really an axiom, yet ships have been built very recently without this precaution. It is unlikely that wood can be avoided altogether, and if a non-combustible substitute is found the danger from fire may be entirely avoided. Until this object has been attained, however, the water pipes must be protected.

The "Vizcaya" was badly riddled by shot and shell, but her death blow was probably dealt by one of her own torpedoes, from which we learn the importance of using only submerged, if any, torpedo tubes, on cruisers and battleships. If these are below the protective deck and below the water line, they are as safe as they can be made. Because none of the large ships have been able to use their torpedoes, many have thought it useless to provide them for large vessels, but such a conclusion seems unnecessary. Also, the torpedo boat has not occupied a prominent part on either side, but we should say that the experience with these boats is merely inconclusive, except as regards the futility of torpedo-boat attacks by daylight.

The relative values of large and small calibre guns has long been a bone of contention, and the importance of the secondary rapid-fire batteries was most clearly illustrated at Santiago, where the rapidity of the fire from the small guns very soon drove the Spanish gunners from their positions. The absence of adequate protection of the secondary batteries on the Spanish vessels contributed largely to their loss by readering the gun positions untenable. It is somewhat surprising that the big guns did not do more damage. The conditions, however, were more favorable to the use of the secondary batteries, and, had it not been a "running" fight, the 12 and 13-inch guns would have taken a larger share of the work. Only one of the large projectiles hit a Spanish ship, yet the accuracy and effectiveness of the smaller guns was wonderful. On the other hand, reports say that a 13-inch shell was placed in the fire room of one of the Spanish torpedo boat destryers, which answers criticisms as to the accuracy of their fire. We are told that the "Cristobal Colon" was hit eight times by the rapid-fire projectiles, though she was protected somewhat by the other ships; the "Vizcaya" was hit 24 times, the "Infanta Maria Teresa" 33 times, and the "Almirante Oquendo" 66 times. Some of this was due to the rapidity of the fire.

Among the constructive features, high speed is seen to be of the greatest value, and this introduces the element of the condition of the mechanical appliances with which all war vessels are crowded. The battleship has risen in the estimation of naval authorities, which is largely due to the work of a department not yet mentioned.

The condition of the machinery of the American ships stood for much, and greatest credit should be given the engineers' department for the way the vessels got into action without any warning whatever. Battleships are not expected to catch cruisers, yet the capture of the "Colon" was undoubtedly due to the splendid work of the engineers of the "Oregon." This, and the wonderful trip of this ship from Mare Island to Jupiter Inlet, and her captain's report that she was ready for action on arrival, should everlastingly set at rest all question of who should govern in the engine rooms of our naval vessels. The engineer is not, and never has been, a "non-combatant," but rather a fighter of the first importance. Ships with guns ever so well handled, and armor and armament perfect, would yet be helpless with weakness in the engine room. All honor and credit to the gunners for their superb marksmanship; their work is so clearly seen in the holes they make that there is little danger of their being unappreciated, but it must not be forgotten that long, patient, preparatory toil by the engineers, and most heroic devotion by those below the water line in the fights, make it possible for the gunners to land their shots.

Some time we shall know the story of the Santiago fight from the engine room and the fire room, and it will equal, if not surpass, those already told from the turret and the deck. This is an engineers' war, and nowhere is the superiority of our ships more clear than in their mechanical departments. We have had good guns and superior shooting in other wars, but we never had such ships, such engines or such engineers before.

When the naval personnel question comes up again for final settlement, these things should be remembered, for guns and armor markmanship and seamanship depend at last upon the engineer.

Summarizing, we should say: Gun practice should be encouraged; efficiency of secondary batteries should be the best to be had; the men should be protected at the rapid-fire guns; unnecessary fuel for conflagration should be avoided; the vital apparatus of ships should be below the protective deck; torpedoes should be kept below the water line; possibilities for securing maximum speed should always be kept in mind; and, finally, the mechanical department should be provided with every facility and every encouragement for maximum efficiency. More will yet be learned, but, if it is well learned, this is enough for one war.

NOTES.

The Atchison, Topeka & Santa Fe has every engine on the system running under the pooling plan.

By taking old ties from the road to the shops and burning them under stationary boilers, the Atchison, Topeka & Santa Fe saves $25,000 per year.

A 33-knot, 350-ton torpedo boat destroyer, the "Express," is now building for the English navy by Laird Brothers, at Birkenhead. Her engines are to indicate 9,250 horse-power.

The largest cargo of steel rails ever sent out of Baltimore was shipped on the British steamer "Knight Companion" June 28 to Vladivostok, Russia. It was valued at $120,150.

The boilers of the British battleship "Albion," recently launched at Blackwall, will carry a pressure of 300 pounds per square inch, which will be reduced to 250 pounds at the engines. She will have 20 Belleville boilers fitted with special feed water heaters or economizers.

A simple way to increase the output of a driving wheel lathe was recently illustrated in the "American Machinist." It makes use of three small screw jacks, held in the slots of the face plate of the lathe and screwed out against the rim of the wheel just under the tire. The jacks serve to steady the work and reduce the time required for turning from 11½ to 5½ hours and reduces the cost from $3.25 to $1.75 per tire. The feed was increased from 1-16 inch to 7-32 inch, and the cut was also increased to correspond.

The light-house equipment in the charge of the United States Light House Establishment at the close of the year 1897 is stated in the report of that department, just issued, to be as follows:

Light-houses and beacon lights	1,116
Light-vessels in position	42
Light-vessels for relief	5
Electric lighted buoys in position	11

Gas lighted buoys in position	30
Fog signals operated by steam, caloric or oil engines	149
Fog signals operated by clockwork	205
Post lights	1,779
Day or unlighted beacons	424
Whistling buoys in position	71
Bell buoys in position	112
Other buoys in position	4,710

It is stated officially, says "Engineering," that an important amendment of the Patent Law of Aus...a will come into force in January next. Patents will be granted for fifteen years for industrial inventions, excluding artic.es of food, medicines, disinfectants, or chemical products not produced by a new technical process. Prior publication in another country will prevent a valid patent being obtained in Austria. The Patent Office has the power to grant compulsory licenses if the inventor declines to allow his invention to be used, but the onerous and unsatisfactory provisions as to working patents which at present exist in Austria will be practically done away with. Annual renewal fees will be charged on an ascending scale.

A very heavy train was hauled May 10 on the Chicago & Eastern Illinois by a single consolidation engine from Danville to Chicago. The total weight of the train, including engine and tender, was 6,510,000 pounds, divided as follows:

Locomotive, with tender	268,000
Cars, each 16½ tons	1,815,000
Coal, 40 tons in each car	4,400,000
Caboose	27,000
Total weight of train, pounds	6,510,000

The train was made up at Danville of engine No. 129, 55 coal cars of 80,000 pounds capacity and a caboose, and was hauled to Chicago under an average running time of over twenty miles an hour. The line is by no means level, the heaviest of several long grades being 21 feet per mile.

The "Kaiser Friedrich," the running mate of the "Kaiser Wilhelm der Grosse," arrived at New York June 17 on what was intended to be a record-breaking trip, but, owing to trouble with her machinery, which had not been "broken in" at all before the trip, she made a slow run. The ship is 600 feet long over all, 64 feet in breadth and 41 feet in depth from the keel to the upper deck. Her displacement, loaded at 28 feet draught, is 17,000 tons. She has twin screws and 5 cylinder quadruple expansion engines, the high pressure 43 inches and first intermediate 64 inches being tandem and the low pressure 93 inches each, while the second intermediate is 92 inches in diameter. There are nine double-ended boilers and one set of three boilers was placed abaft the engines. This gives a shaft about 248 feet long. There are 183 men in the engineering staff.

New locomotive coaling stations having improved facilities have been erected at a number of points on the Northern Pacific Railway, where comparatively few locomotives are supplied, and they are so arranged as to be cared for by a man who may also look after water pumping. The stations have two coal pockets of 35 tons capacity each, while a track pit brings up the storage capacity to 100 tons. The coal is shoveled from the car into a conveyor driven by a 4½ horsepower gasoline engine, which will elevate one-half ton per minute and dump it into the bins. The bins are equipped with Mr. E. H. McHenry's dynamometer, which accurately weighs the coal in each pocket, and enables enginemen to know how much coal they receive. This is a very compact and convenient arrangement.

A chronograph for recording exceedingly small intervals of time, such as a millionth of a second or less, has been used to record autographically the compression by a blow of a cylindrical piece of copper. In one case a 33-pound weight fell 15 in. and produced a permanent compression of 0.1658 in. in a copper cylinder, the time consumed in producing the compression being 0.0030317 of a second. The machine produces by photography a curve showing the progress of the compression. The chronograph consists of a rotating cylinder, with a surface velocity of about 100 ft. per second, on which is photographed a pencil of light, which is passed through a hole in the end of a rapidly vibrating tuning fork. The delicacy of this instrument is far greater than that of the ordinary tuning fork chronograph, in which the record is made on a surface blackened by smoke.—[Engineering and Mining Journal.

Long distance runs are common on English railroads. The following table, reprinted from "The Mechanical Engineer," gives an idea of the long-distance running on the London & North-Western this summer:

	Miles.	Trains.
London—Crewe	158	5
Crewe—Carlisle	142	5
Carlisle—Crewe	142	5
Crewe—Willesden	153	6
Willesden—Stafford	128	1
Stafford—Willesden	128	1
Stoke—Willesden	140	1
Stafford—Holyhead	130	1
Crewe—Holyhead	106	1
Holyhead—Crewe	106	1
Northampton—Chester	116	1
Wigan—Carlisle	106	2

From this it will be seen that thirty trains are booked to run over 100 miles without a stop. In nearly all cases the speed is fifty miles an hour and over.

It is estimated that labor in the railroad industry absorbs from 60 to 70 per cent. of the money spent for operating expenses. On some roads it will be less, owing to traffic being lighter. In some departments, moreover, it takes a much larger percentage than others. Here are some figures from the last report of the Chicago & Northwestern, which serve as an example as to the respective cost of labor and material in each department:

	Labor.	Material.
Maintenance of way	$2,873,032.36	$1,269,985.03
Maintenance of equipment	1,335,184.42	1,698,003.58
Conducting transportation	7,244,017.32	3,757,453.90
General expenses	448,573.55	250,839.09
Totals	$11,900,807.65	$6,976,281.60

When expenses have to be reduced the great bulk of the reduction must fall upon the labor and not the material account.—New York "Commercial."

Very satisfactory cement for leather belting has been manufactured by kneading ten parts of carbon bisulphide and one part of oil of turpentine with guttapercha until a thick paste is the result. The portions of the leather where the cement is to be applied are to be unrolled and roughened, the cement put on, and the ends pressed together until the binding agent has become dry. Good caoutchuc cements, too, for rubber strips or rubber goods on metal are obtainable by dissolving shellac in ten times its weight of ammonia, and, after standing for three to four weeks, a transparent putty results, which is used without heating. The cemented places soften at first, but become hard and firm after evaporation of the ammonia, which may be assisted by heating. This cement is watertight and gasproof, and is efficient for hard rubber articles—a mixture of guttapercha and asphalt being also serviceable in the same line.—"Engineering and Mining Journal."

A notable engineering feat was consummated recently at Bismarck, N. D. The east pier of the Northern Pacific Railway bridge, which spans the Missouri River at that point and weighs over 9,000,000 pounds, was moved from its foundation and slid on steel rollers a distance of nearly 4 feet to the new foundation. Preparations for this event had occupied a period of eight months, but the great event itself required less than a minute of time. Within sixty seconds a solid mass of granite weighing, with its pier and span, over 4,700 tons, was slid forward and rested upon the new foundation. The moving of the pier was necessary from the fact that it was displaced by the sliding of earth beneath the foundation several

years ago, and to correct the difficulty permanently it was decided to build a new foundation and move it back to the place from which it had slipped. The plans for the work, which is entirely unique in engineering, were prepared under the direction of Chief Engineer E. H. McHenry, of the Northern Pacific Road, and the work has been carried forward without interruption of traffic.

Staybolt failures to a sufficient number to cause boiler explosions are not confined to this country, as is shown by Sir Francis Marindin's report just submitted to the English Board of Trade upon the collapse of a locomotive firebox on the Belfast & Northern Counties Railway a year ago. The engine was built in 1890, and was thoroughly overhauled about four months prior to the accident. The firebox was of copper and the boiler, when it left the shops, was in good condition, safe for service. The accident occurred while the train was approaching a station at a speed of about 25 miles per hour. The inspector found that the engine had for some time been running with a number of broken and flawed stays on the right side of the firebox, and he believed that the number of these defective stays gradually increased until the point was reached when, owing to insufficient support, the plate suddenly collapsed. Sir Francis Marindin says that the only way to guard against such accidents is to have frequent examinations, more worthy of the name than those hitherto relied upon, and he reports that on the Belfast & Northern Counties line the boiler examiner is now required to make a proper examination of all boilers once a week.

The steaming radius of our naval vessels has been a subject of interest, and is clearly one of great importance in naval warfare. It is clear that speed and coal carrying capacity may determine success or defeat, steam colliers being at best but a very unsatisfactory, though necessary, adjunct to a naval formation. The comparative coal capacities of our principal ships has been formulated by the bureau of steam engineering as follows:

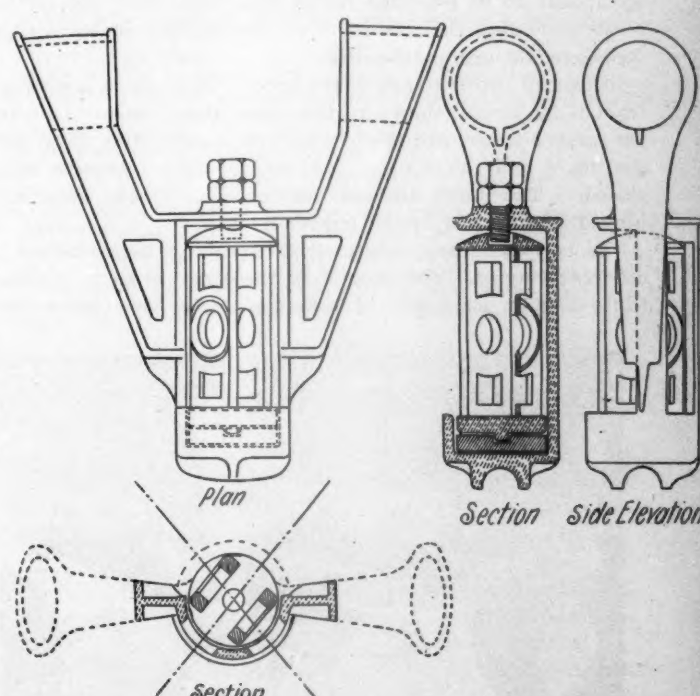
Ship.	Type.	Coal bunker capacity	Steaming radius on this coal at most economic rate.	Steaming radius on this coal at maximum speed with forced draft.
		Tons.	Knots.	Knots.
Iowa	First-class battleship	1.790	a6,000	b2 355
Indiana	" "	1 550	4,805	b2,671
Massachusetts	" "	1,560	4,797	b2,265
Oregon	" "	1,540	5,205	c2,448
Brooklyn	Armored cruiser.	1.300	4,342	b1,404
New York	" "	1 200	4,486	b1,344
Columbia	Protected cruiser	1,600	a7,000	b1.840
Minneapolis	" "	1,420	6,824	b1,565
Olympia	" "	1,100	6,105	c1,408

a Estimated.
b From official trial, actual figures.
c From official trial on basis of 2.4 pounds of coal per indicated horse power.

The life of wooden piles used in bridges on the Chicago, Milwaukee & St. Paul Ry. was recorded by Mr. William Gannon at a recent meeting of the employees of the bridge and building department of that road as follows: "We use white oak, cedar, Norway, white pine and tamarack for piling in the pile bridges, the greater proportion being white oak. The thin bark, white oak piles from Wisconsin will last from 11 to 20 years; 20 years in wet clay soil and 11 years in sandy soil. The Southern oak piles are not as good as the Norway or pine piles; the sap, which is about three inches thick, decays in three years, and then worms and beetles go into the piles at the surface of the ground and work down from one foot to three feet, and in one or two years' time eat the piles entirely off if not disturbed or drowned by wet weather. By removing the dirt about two feet deep around the piles when the worms first commence to work in them, and removing the sap rot, it disturbs the worms, and the remainder of the pile hardens and stops decaying and will last two or three years longer. The white cedar piles will last in sandy soil from 10 to 12 years, and in wet, clay soil from 22 to 30 years. They are brittle and do not hold spikes, and should not be used on curves or grades over eight feet to ten feet high. Piles of Norway pine, white pine and tamarack last from four to ten years, according to circumstances, and are not satisfactory for use in ordinary pile bridges. Hemlock, or cottonwood, for piles or timber should not be used in any bridge, as it decays in the center and shows fair and good on the outside. Water elm is not much better than hemlock.

CUSHIONED AND REVERSIBLE BRAKE BEAM STRUT.

The Monarch Brake Beam Company (Limited) of Detroit, Mich., exhibited a new reversible cushioned brake beam strut at the recent conventions at Saratoga, N. Y., where it attracted considerable attention among railroad men. Our engraving shows how it is made. The strut is so formed as to receive the fulcrum piece on pivots, which allow it to be reversed for use either as a right-hand or left-hand beam without requiring additional parts for such a change. The drawing shows the strut and fulcrum piece in section, making the construction and attachment clear. The cushion is inserted between the fulcrum piece and the seat in the body of the strut, the intention



The Monarch Cushioned and Reversible Brake Beam Strut.

being to provide enough elasticity in the rubber block to prevent clattering of the brake shoes and sliding of the wheels. The rubber block is secured in a recess in the strut and the strut is rigidly attached to the brake beam. The form of this strut is such as to permit its use with the solid beam manufactured by this company. Since exhibiting the strut at Saratoga the company has taken a number of orders to equip passenger cars with it. It is the invention of Mr. Thomas E. Carliss, Superintendent of the Monarch Brake Beam Company (Ltd.).

The "Railway Age" deserved the thanks of the conventions for the 'Daily" published at Saratoga this year. It was better than ever.

THE JOHNSON HOPPER DOOR.

Our three engravings show a new type of fastening for the hopper doors of coal and ore cars which after critical examination leads to the conclusion that it will work satisfactorily and fulfill the severe requirements of such fastenings. Hopper doors must be safe against accidental opening, they must be tight and the mechanism must be simple in order to be easily operated and economically maintained; also the devices must be self contained, not requiring levers or wrenches, and the mechanism must be sufficiently strong to resist strains from

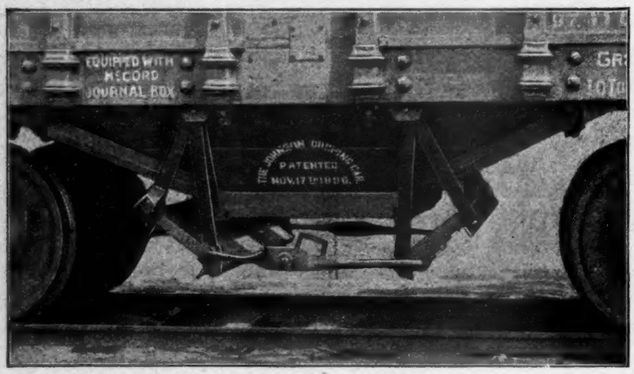


Fig. 1.

material clogging the doors or from freezing. These requisites all appear to be provided for in this door, with the further recommendation that the parts are not liable to damage when doors are left open on the road.

Instead of being hinged to the hopper these doors are swung from it by straps, shown in the engravings, the pivots being the hopper irons, and the effect of its construction is to bind the doors and the hopper together, insuring tightness when closed. The doors are not different from those used with hinged connections to the hopper direct.

The two doors are connected by a pair of toggle levers of different lengths. The shorter of these two arms is fastened to its door by a bracket. The longer arm is bent into a shaft

Fig. 2.

running across the bottom of its door to the other side and is bent around again to form the longer arm on the other side of the hopper. The arrangement of each side being the same it is possible to open or close the doors from either side. The operation is shown in the three views given. Fig. 1 shows the doors in the open position. In order to close them the operator grasps the hand-hold and lifts it to the position shown in Fig. 2. From that point he pushes the toggles in front of him, folding the two levers upon one another and laying them down upon a bracket placed upon the outer edge of left hand side of the hopper. In folding the toggles he has rotated the levers until the line of the longer lever has passed the dead center of the pivot of the shorter lever. When the load comes upon the doors there is then a compression strain on the shorter lever and a tensile strain on the longer, the two forces counteracting one another and preventing any movement of the doors. The natural tendency would be to rotate the two still further down, but the bracket prevents this. No motion of the doors is possible without raising the two levers above the dead center mentioned. The operation in opening is the reverse of the one described. The operator raises the two levers above the dead center and the load swings the doors downward and backward out of the way.

The experience of 16 months' service has satisfied McCord & Company, of 100 Broadway, New York, and Old Colony Building, Chicago, who control the device, that it will substantiate all claims made for it, and they are strong ones. We reproduce some of these as follows:

It locks automatically and when locked, owing to its positive fastening, the door is held tight against the bottom of the hopper, and sagging down is impossible.

All of its attachments and fastenings are outside of the hopper, and when open, outside of the path of the load, removing any danger of damage from the load in passing out.

These attachments being outside of the hopper makes it easy to open or close the door in all kinds of weather. In fact, a

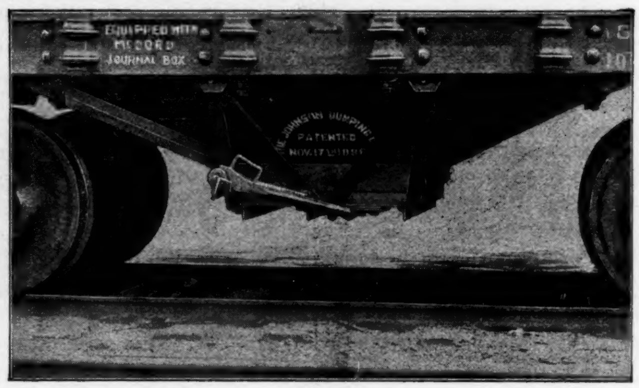


Fig. 3.

large leverage is secured to release the doors in case they should be frozen against the bottom of the load.

In opening, the doors do not approach much nearer the track than in the closed position and are therefore not apt to be damaged if left open.

As the doors do not swing down toward the track, the width of the hopper opening is not limited by this distance, and if necessary a much wider opening can be secured.

It may be applied to the ordinary style of hopper and does not require any change in the construction of the car.

FIREROOMS IN THE TROPICS.

Writing from Key West, June 13, a "New York Press" correspondent says: "An engine room and a stokehold on our war vessels are not, even in high latitudes, places where one would seek to cool a fevered brow, but in the tropics they become counterparts of pits infernal. Some of the more pessimistic officers of the navy are afraid that if the war is drawn out long the firemen of the fleet will be unable to stand the strain, and that when the break comes they will go by the dozens. So far they have stood it well. But they have suffered much, and the heroism of cleaning a fire in the bowels of a blistering warship on the Caribbean Sea is of the hourly and every-day kind that receives neither reward nor glory. Frequently when the 'New York Press" dispatch boat, on which I have been, was cruising on the south side of Cuba, the thermometer in the cook's galley, a small deckhouse with doors open on either side, registered 135 degrees and would have registered more if the thermometer had been graduated higher. What must have been the heat in the fireroom? Almost naked skeletons of men, hoisted up to the deck to lie gasping until revived by outward applications of water and inward applications of stimulants, told us of the terrors of those superheated depths."

GUNN'S RUNNING BOARD BRACKET.

Several years ago Mr. Robert Gunn, foreman of car repairs, Erie Railroad, devised and patented the malleable iron running board bracket shown in the accompanying engraving and it has been adopted as a standard on that road, where it has been in successful use for four years, during which time there have been no cases of loose running boards. It was very strongly indorsed by Mr. A. E. Mitchell, Superintendent of Motive Power of the road, in one of the discussions before the Master Car Builders' Association, who stated that no other form of running board fastening had been applied to box and stocks cars of the Erie Railway since 1894. It is also used on all cars passing through the shops for general repairs when new roofs are required. With the ordinary wooden bracket running boards warp out of shape and by their springing the

Malleable Iron Running Board Bracket.

nails are partly pulled out, causing brakemen to trip as well as rendering the roofs liable to blow off. Mr. Gunn presents the following claims for the device:

It provides a safe walk for trainmen, it tends to hold the roofs secure by preventing them from blowing off, it is of malleable iron and will last longer than the car and saves expensive repairs due to the frequent attention required for maintaining the ordinary running board fastenings.

The total length of this bracket is 2 ft. 2¼ in., its height at the ends is 2⅞ in. and at the center 1⅛ in. The device is made to strengthen the car roof by the passage of the bolts that secure the brackets to the car through the carlines as well as through the brackets. Three eighth-inch bolts are used for this, with nuts on each end. The holes for the bolts that hold the running boards to the brackets are slotted out as shown in the engraving. The holding down bolts have wings with flat surfaces 1½ in. from the under sides of the upper nuts, to bear against the top faces of the roof strips so that the running board brackets may be removed without taking out the bolts. This construction helps to strengthen the roof. The device is a very simple affair but it is a good one and is important in that it tends to render this part of car construction more permanent than it otherwise would be.

The brackets are made by the Dayton Malleable Iron Company, of Dayton, Ohio.

The Bettendorf bolster of the Cloud Steel Truck Company was specified for 1,000 freight cars of 70,000 lbs. capacity, to be built for the Northern Pacific Railway by the Michigan Peninsular Car Company. These bolsters and also the Cloud steel trucks were also specified for 100 box cars, 50 stock cars and 25 coal cars, to be built for the St. Joseph & Grand Island R. R. by the Mt. Vernon Car & Manufacturing Co.

TONNAGE RATING FOR LOCOMOTIVES

The report on the subject of tonnage rating as submitted to the Master Mechanics' Association at the recent convention is given in abstract as follows:

In order to determine the value and success of the tonnage method of rating locomotives in comparison with other methods of making up trains, a circular was sent out, under date of October 5, 1897, asking for definite information on this point. Forty-three roads in the United States, Canada and Mexico, operating over 66,000 miles of track, reported that they were using the tonnage method; some had been working this way for fifteen years, and some for only three months, with an average for all the roads of possibly two years, but the advantages derived were all of the same order, and may be comprehended, generally, by the following statement:

Heavier average trains hauled with less stalling; more uniform loads and better condition of engines, particularly the tubes, on account of not being overloaded; less engine and more car mileage; less friction between Motive Power and Transportation Departments, and more satisfactory results in every way.

Various estimates of the increase in trains handled under this method were given, which ranged from 10 per cent. to 43 per cent., but it is probable that the average will fall between 10 and 20 per cent. The figures, too, came from every variety of road, from the level and straight shore roads, and the undulating prairie roads, to the crooked mountain lines of the Appalachian and the Rocky ranges.

One of the first questions which arises when the desire to adopt the tonnage method of rating has aroused us is, how to obtain the proper rating for the different engines on the various portions of the road. The practical method naturally suggests itself first; that is, try it for each class of engine on each critical or controlling part of the division and keep on trying to see what can be pulled, till you reach the limit. While this method has been used on twenty-two of the lines reporting, yet we believe that results can generally be secured more quickly and satisfactorily by first producing the theoretical rating and then checking these figures by actual trials under various conditions of weather, etc. Fourteen roads have handled the subject in this way, while six have been content with a theoretical rating alone.

We have stated above that it is our opinion that the theoretical rating will be of great advantage in inaugurating tonnage rating, but to gain the greatest benefits from it it is necessary that it be fairly accurate in defining the work for different locomotives and localities. We will now attempt to show how the rating may be determined in advance of the trials, or even the completion of the road, provided the profile and alignment can be obtained. Mr. Tweedy, Chief Engineer, Wisconsin Central Lines, who has been much interested in the subject, says: "I am convinced that if some one would take sufficient time and pay enough attention to the matter, that it would not be very hard to get up a table that would be so accurate that every part of a road could be rated theoretically in the office from the track profile, and in such a manner that the results would be practically satisfactory."

We will enumerate the several factors which may be considered in producing the theoretical rating:

Power of the locomotive; adhesion of the locomotive; resistance of trains; value of momentum; effect of empty cars; effect of weather and seasons.

The starting point in all locomotive ratings is the power of the machine. The report of last year's Committee on Grate Area and Heating Surface, [See American Engineer, July, 1897, p. 251.—Editor], under the heading "Tractive Force," gave formulæ for making these calculations, and Diagram No. 2 gave information regarding the mean effective pressure. It will possibly be more convenient for our present purposes to put this formula in a slightly different form. At slow speeds, say 50 to 75 revolutions per minute, with reverse lever in corner and a cut-off of 90 per cent. (which is common among freight engines), we may consider that:

Initial pressure..........................	=	.95 boiler pressure
Mean effective pressure..................	=	.91 initial pressure
Mean effective pressure..................	=	.86 boiler pressure
Allowing 8 per cent. for friction.........	=	.92 M. E. P.
Mean available pressure..................	=	.80 boiler pressure

The value ".91" is obtained from Diagram No. 2 of the report above mentioned. Wellington (page 531) thinks 8 per cent. sufficient for internal friction. The result 80 per cent. boiler pressure agrees with figures assumed by the Baldwin Locomotive Works on page 87 of their new catalogue of narrow gauge locomotives, for working at slow speeds. The maximum speed at which these figures will apply is probably seven miles an hour for 50-inch wheels, eight miles an hour for 55-inch, and nine miles for 60-inch wheels.

From the mean available pressure, the tractive force may be computed by this formula:

$$\frac{p\,d^2\,s}{D} = \text{Tractive force in pounds.}$$

Where p = Mean available pressure in pounds per square inch.
d = Diameter of cylinder in inches.
s = Stroke in inches.
D = Diameter of driving wheels in inches.

This is clear of friction and represents the force exerted at the rails. Of course, the resistance of locomotive and tender must be deducted to get the net pull-back of tender.

We have stated above that the maximum tractive force could only be obtained at slow speeds—it is obvious that the boiler is totally insufficient to supply the quantity of steam for this force at high speeds. It will, therefore, be necessary to determine approximately the maximum tractive force at various speeds of which the engine is capable. If we assume that the grate area and heating surface have the values assigned by the committee last year, viz: three times the total cylinder volume for grate area, and 200 times for heating surface, in bituminous coal-burning engines, the units being square and cubic feet (page 230, M. M. Report for 1897), and the maximum rate of combustion to be 160 pounds per square foot grate area per hour, we should have (from Diagram No. 4 of previous report) an evaporation of six pounds water per pound of coal, from and at 212 degrees. This would give us:

$3 V \times 160 \times 6 = 2{,}880 V$ = pounds water evaporated per hour

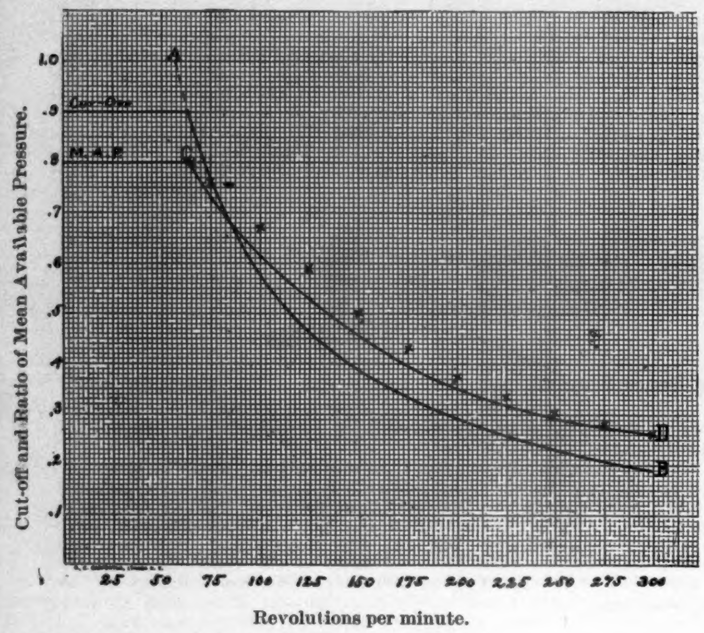


Diagram No. 2, 1898 Report.

from and at 212 degrees, where V = total cylinder volume in cubic feet.

From Formula 4 (page 227), by substituting X for cut-off and Y for revolutions, we have: $V \times X \times 2 \times Y \times .284 \times 1.2 \times 1.25 \times 60 = 2{,}880 V$ or

$$V \times X \times 2 \times Y \times .284 \times 1.2 \times 1.25 \times 60 = 2{,}880 V \text{ or}$$

$$X\ Y = \frac{2{,}880}{2 \times .284 \times 1.2 \times 1.25 \times 60} = 56{,}33,$$

which is the equation of an equilateral hyperbola.

Diagram No. 2 shows this line marked A—B, in which the ordinates give the cut-off and the abscissæ the revolutions per minute. This curve will be understood as showing the longest cut-off for which the boiler will furnish steam at the various speeds.

By means of Diagram No. 2 (last year's report), we can construct the line C—D, which shows the mean avaliable pressure which may be expected at each speed.

The series of points X X, show the values assumed for this maximum pressure by the Schenectady Locomotive Works on page 222 of their catalogue of 1897, when the stroke is 24 inches. Of course, differences in proportions of locomotives and valve gears will vary the power somewhat.

The Master Mechanics' Committee in 1887 recommended for freight engines, $\frac{P\ d^2\ s}{D} = .26$ W, P being the boiler pressure, or with a mean effective pressure of $.86\ P = p$, $\frac{p\ d^2\ s}{D} = .22$ W, where W = weight on drivers, or coefficient of friction taken at 22 per cent. (This is the figure adopted in last year's report.) Recently locomotives with pneumatic sanders have given satisfactory service where $\frac{P\ d^2}{D} = .31$ W, or for $p = .86$ P, $\frac{p\ d^2\ s}{D} = .27$ W, or omitting effect of angularity of connecting rod and considering $p = .80$ P, so as to include friction, we have $\frac{p\ d^2\ s}{D} = .25$ W, or friction at 25 per cent.

Baldwin Locomotive Works Catalogue of 1897 (page 88), and Wellington's "Railway Location" (page 437), state that under favorable conditions 25 per cent. friction may be realized, but that in winter and under general conditions the friction may amount to only 20 to 22½ per cent.; we can, therefore, consider that the friction will be ordinarily 25 per cent. with good sanding apparatus, and about 21 per cent. without such apparatus, so that $\frac{p\ d^2\ s}{D}$ should be = or $<$ .25 W or .21 W, respectively, where $p = 80$ per cent. of the boiler pressure in order not to slip the drivers at slow speed.

Diagram No. 1 [See American Engineer, June, 1898, Fig. 4, page 197.—Editor], reproduced from last year's report on Cylinder Volume, Grate Area, etc., gives the probable resistance of trains due to speed, grade, curvature and acceleration, and your committee sees no necessity for making any changes in this chart. A grade will generally have some curves upon it, and, if sharp, these may constitute a critical or stalling point for heavy trains. The allowance for curvature will, of course, give the power necessary to pass such points, but generally in calculating the load for a locomotive the curvature function may be omitted or reduced to a general average, as in passing through a curve a small loss of velocity will afford sufficient force to take the train around it. So, also, the average grade should generally be taken instead of the maximum, if the latter occurs in short stretches, where the same small loss in velocity would help the trains over. If there is to be much variation in the seeed, the coefficient for this feature should be modified accordingly. Page 544 of Wellington's "Railway Location" gives some interesting tables on this subject.

While in mountainous regions, with long, heavy grades, there is little opportunity to take advantage of the force due to momentum, in undulating portions it may be utilized with the greatest advantage. A velocity of approach to a grade, when it can be reduced in ascending the grade, enables the engine to haul greater loads than it could without such assistance. This is well illustrated on the Norfolk division of the Norfolk & Western. The grade out of Petersburg, going east, is thirty-seven feet, and is about four miles long. As all trains stop at Petersburg, they are not able to get the benefit of momentum, and a helper is necessary to get over the hill; the summit being passed, the helper returns. A few miles farther, the same grade exists—8,000 feet long—but at this point a preceding down grade enables them to obtain sufficient velocity to pull the train up with one engine that at Petersburg required two. This illustrates how stops, crossings, curves, water tanks, etc., will interfere with the make-up of a train, if so located as to prevent the use of momentum, and it is necessary to bear all these points in mind when figuring the rating for an undulating division. Many railway officers contend that the gain from momentum cannot be figured, and while it is difficult to arrive at very accurate figures, yet we think that a fair degree of success may be obtained by carefully considering the various factors in the case.

Effect of Empty Cars.—Wellington considers that the resistance per ton for empty cars varies from 30 to 40 per cent. more than that of loaded cars, on a level. Experiments on the Chicago, Burlington & Quincy showed about 50 per cent. more resistance on a level and about 7 per cent. more on a 30-foot grade. The location of loaded cars in a mixed train did not seem to materially affect the results.

Some recent experiments on level roads seemed to indicate that the resistance per car was nearly equal for empties and loads, but we do not believe that this would generally apply.

Sixteen roads reported making no allowance for empty cars. This may mean, in some cases, that the traffic is largely in one direction, and that there are not enough empties to load engines to their capacity when returning the cars. One road allows 8 per cent. excess, three roads, 10 per cent., two roads 25 per cent.; one road 5 tons, and one road assumes that they weigh 13 tons each. We also see allowances of 3 empties to 2 loads, 2 to 1, 5 to 2, 5 to 3, and 6 to 5.

Mr. McHenry, Chief Engineer of the Northern Pacific, has provided a triangular chart which covers empty, partly loaded and fully loaded cars, but each rate of grade requires a separate chart. Mr. Tracy Lyon, Master Mechanic of the Chicago Great Western, has formulated another, which requires a special line or locus for each class of engine. Both of these were recently illustrated in a paper read by Mr. L. R. Pomeroy before the New York Railroad Club, January 20, 1898. [See American Engineer, February, 1898, p. 65.—Editor.]

Mr. Lyon considers that the resistance per ton of an empty car is two pounds greater than a loaded car. If we take an increase of 30 per cent. for loaded cars on the level, we have 1.8 pounds at a speed of fifteen miles per hour, where the train resistance is six pounds, and this 1.8 pounds should be added to the regular resistance per ton. On grades, the effect will diminish in accordance with the formula:

$$e = \frac{1.8}{y_2 + 6}$$

Where e=the proportional increase in resistance of empty cars for the grade given, and y_2 = resistance due to grade in pounds per ton.

The weights of the empties merely to be increased by these amounts when making up the allowance for the engine. While this does not allow for paritally loaded cars, it has the advantage that it is simple and can be easily applied. On momentum grades, the virtual grade should be used in selecting the value of e.

It occurs to your committee that the assignment of loads to engines by yardmasters, dispatchers and others would be greatly facilitated if each engine bore its class mark or letter on some conspicuous part, as, for instance, on the apron of cylinder immediately below the steam chest. This plan has been followed by the Norfolk & Western.

COMO, INTERNATIONAL ELECTRIC EXHIBITION, 1899

Como, the birthplace of Alexander Volta, is preparing to celebrate the centennial anniversary of the invention of the Voltaic battery. The exhibition will be an international one, open from May 15 to Oct. 15, 1899, and foreign electricians are invited to avail themselves of this opportunity for free discussion of the scientific and practical fields of electricity.

Como is a flourishing, industrious, commercial Italian city, situated on the main line of the St. Gothard Railway, about 40 kilometers from Milan. It is pleasantly situated at the foot of the Alps and on the shore of the most charming lake in Lombardy, to which it gives its name.

A special electrical exhibition in Italy is sure to be successful on account of the abundant hydraulic power available for electrical works. The application of this power to the manufacture of silk constitutes an interesting feature of Como, and rapid progress in this direction is now being made, although the city still remains indebted to foreign countries for its machinery and improvements. Foreign inventions will, therefore, be greatly appreciated at the exhibition, and they will be favorably placed among the exhibits. The city of Como, for encouragement, has offered a sum of 10,000 francs in prizes for new inventions.

Communications by mail should be addressed as follows: Comitato, Esecutivo per la Esposizione, Como, Italy.

The Receivers of the Baltimore and Ohio Railroad have turned their attention to the improvement of the grades on the Third Division, from Cumberland to Grafton, or, rather, that portion which lies between Altamont, the top of the 17-mile grade, and Terra Alta, where the Cranberry grade begins to descend. The line passes through Deer Park and Oakland, and crosses what is known as the "Glades" of the Alleghany Mountains. The grades are short and choppy, some of them being 80 to 85 feet to the mile. One of the first pieces of work to be done is now in progress at No. 58 Cut, where the grade is being reduced from 81 feet to 42½ feet per mile, with allowances for curvature. It is expected that the cutting down of this grade will permit of increasing the train load from 1,000 tons to 1,300 tons on east-bound trains. One mile of the roadway will be lowered, and it is expected that the work will be completed by the middle of October.

The bottom of the Pacific, between Hawaii and California, is said to be so level that a railroad could be laid for 500 miles without grading anywhere. This fact was discovered by the United States surveying vessel engaged in making soundings with a view of laying a cable.

The Walker Manufacturing Company, of Cleveland, has just received an order from Paris, France, for a large amount of electric railway equipment. It is substantially the equipment for 500 electric street cars, including 1,000 motors, 1,000 controllers and 500 trolleys. The value of the order is more than a half million dollars. This is another substantial tribute to American electrical machinery.

The Northern Pacific Railway has ordered 14 locomotives from the Schenectady Locomotive Works. Seven are to be 10-wheelers and seven heavy consolidations.

The number of railroad men discharged for excessive use of liquor during the past 22 years, according to Chief Arthur of the Brotherhood of Locomotive Engineers, has decreased from 20 to 1 per cent., and during the past 25 years the proportion of men owning their homes has increased tenfold.

A great achievement in modern railroad transportation has been accomplished near Pittsburg, where molten iron is being hauled a distance of five miles in tanks, from the furnaces to the rolling mills, the expense of a second melting being thus avoided.

Within the past month the first iron bridge erected in the State of Ohio has been removed. This bridge was over Salt Creek, on the Central Ohio division of the Baltimore & Ohio Railroad, in Muskingum County, and was built in 1851. It was a single span, 71 feet in length, and was known as a "Bollman deck truss bridge with plate girders." Bollman was at that time Chief Engineer of Construction of the Baltimore & Ohio Railroad.

BOOKS AND PAMPHLETS.

"A Treatise on the Locomotive Engine." By Maurice Demoulin. With an introduction by Edouard Sauvage; 4 volumes, large oxtavo, 1,978 pages, 973 engravings and six plates. Paris: Baudry & Co., 15 Rue des Saint Peres, 1898. New York agents, Gustav E. Stechert, 9 E. 16th street. Price, 150 francs.

This book, in our opinion, is the most complete and best treatise on the locomotive ever published, and it is a pity that it is not in the English language. It is in four large octavo volumes with tables, plates and nearly 1,000 engravings. Up to date practice in the principal railroad countries of the world is recorded with observations upon the designs of the locomotives used and the reasons for the special lines of practice followed in each country. We shall not attempt to give a detailed outline of the work, because it could not be done in several pages.

Good sound practice is illustrated in general and in detail, and experimental work has no place in the book; it is devoted to the important questions of locomotive designs and operation. The arrangement is logical and convenient, and where it was possible the author gave credit to other publications for illustrations and information used. One of the characteristics of the work is the presentation of information in such form as to admit of comparison of the practice in different countries The book is specially strong in its treatment of combustion and the disposition of fire-boxes and heating surfaces and in showing the disadvantages of forcing. This part of the subject occupies volume II. and in it the exhaustive tests of Henry, Baudry and Prof. Goss are specially referred to and different methods of designing fire-boxes and grates are shown. Interesting and valuable data are given in regard to the length of boiler tubes and the relative values of different forms of heating surfaces. The results of tests in stationary and locomotive practice are compared and a good idea of the thoroughness of the work is seen in the fact that 232 pages are devoted to boiler and fire-box designs. The materials for fire-boxes and boilers have their share of attention.

Cylinder action in the use of steam and condensation and other losses is treated very fully, including comparisons of different arrangements of cylinders.. The author believes that the difficulties in making cranked axles strong enough to withstand the stresses of service as locomotives are made stronger and heavier will tend to increase the use of the outside connected type. Of the various types of compounds he prefers the four-cylinder plan, and believes it to be the one that will be most generally used in the future.

A great many examples are shown to illustrate designs and arrangements of the details of the running gear, and it is apparent that more attention is paid to cab fittings in Europe than in this country. It is also evident that foreign practice leads ours in regard to interchangeability. For example, five different classes of locomotives on the Great Eastern Railway of England use the same fire-box and boiler. Lubricants and lubrications are treated in an excellent chapter, and copies of specifications for American, English, French, German and Belgian engines are given.

The type, engravings, paper and binding are all in keeping with the high character of the work, and not the least interesting part is the introduction from the pen of Mr. Edouard Sauvage. The book undoubtedly will have a large sale, but it would have a much larger one if it had been written in English.

"Introductory Course in Mechanical Drawing," by J. C. Tracy, C. E., Instructor in the Sheffield Scientific School of Yale University, with a chapter in perspective by E. H. Lockwood, M. E., Instructor in the Sheffield Scientific School, New York and London. Harper & Bros. Cloth, 8 by 11 inches, pp. 100, with 163 illustrations and 8 plates. Price, $2.00.

The author states in the preface that the book is intended for beginners and is to prepare the student for more extended

courses in any of the special lines of drafting. The endeavor has been made to make it comprehensive enough for use in schools and colleges and at the same time to have it meet the needs of the student who must work without the help of a teacher. The first three chapters are preparatory, dealing with instruments and the preparation for work. These are followed by three chapters on isometric, cabinet and orthographic projections. The next subject is perspective, and the closing chapter takes up working drawings. We should say that the author has carried out his plan most admirably and he has certainly succeeded in presenting the subject in a simple and clear way, discussing principles and leaving the application of them to difficult and advanced subjects to be worked out later. A student or apprentice may learn to draw by a careful use of this book, and we shall go farther than this and say that it offers a method which we believe to be superior to that in use in many of our technical schools. The courses have been well arranged and the time required on each is stated. The engravings are admirable and teachers will find much to interest them in the use that has been made of photographs from models. It is the best introductory work in drawing that has been published.

"The General Manager's Story." Old Time Reminiscences of Railroading in the United States by Herbert Elliott Hamblen. The Macmillan Co., 66 Fifth avenue, New York. 311 pages, illustrated, 1898. Price, $1.50.

This is a book that will be finished by those who begin to read it. It is the story of the anthor's fifteen years' of experience as a railroad man in passing through various grades from freight yard switching to the office of general manager. It is an exciting, entertaining story, faithfully portraying railroad life and particularly that of train service. As a story it is weak in spots, and includes some exaggeration, but it is generally true to life. The author's knowledge of the operation of the locomotive is thorough and this is the strongest factor in the work.

We should say that very few men have gone through this long list of experiences which are said have really happened to the author, yet it is possible for as much to occur to a man, and we think of several such men who have been through it all. The book records the life, thought, characteristic language and strong self reliant manhood of railroad men. The illustrations are excellent. They are so accurate in proportion and in spirit as to lead to the conclusion that the artist must have spent a long time in studying the subjects. They add greatly to the interest and appearance of the book. We have not space for all we would like to say of the book, but it is perhaps enough to say that those who read it will pass it over to some one else, with confidence that it will give pleasure and no disappointment. We do not know where to look for an account which so accurately presents the conditions which have given this country its remarkable railroad men.

"The Locomotive Link Motion." By F. A. Halsey, Associate Editor "American Machinist." 81 6x9 inch pages, with 46 illustrations. Locomotive Engineering, 256 Broadway, New York. 1898. Price, $1.00.

This is an exceedingly valuable book. It is a study of locomotive link motion in which is developed the fact that there were two hitherto unsuspected errors in the motion due to the location of the eccentric rod pins back of the link arc and the angular vibrations of the eccentric rods, which errors combined with the one due to the connecting rods produce a final error which is corrected by locating the saddle back pin of the link arc, and the connecting rod, instead of being a disturbing factor, as has always been believed, is really a corrective one. The author contends that instead of being a faulty valve motion the Stephenson link motion is probably the best that can be found for locomotive work, and his study of the subject has been so thorough as to make him an authority. The book places a series of articles which appeared last year in the "American Machinist" in convenient form somewhat elaborated and enlarged. The Bilgram diagram is used and the study of the subject resulted from an invitation from the Schenectady Locomotive Works to use their facilities for the preparation of a comprehensive account of present locomotive link motion practice. Mr. Halsey's "Slide Valve Gears," published several years ago by the D. Van Nostrand Co., is familiar to our readers, and the part of the present work devoted to plain slide valves is reproduced from that book. The practice of the Schenectady people in equalizing the lead, port opening and cut off for any point of stroke is indicated in a series of tables. The book is commended to all who have to do with link motions, especially as applied to locomotives.

"American Railway Bridges and Buildings, Official Reports of the Association of Railway Superintendents of Bridges and Buildings." Compiled and edited by Walter G. Berg, Principal Assistant Engineer Lehigh Valley Railroad, President Association of Railway Superintendents Bridges and Buildings. 706 pp., 250 illustrations, cloth, price $2.50. Published by "The Roadmaster and Foreman," 91 South Jefferson street, Chicago, 1898.

This book presents the proceedings, reports and discussions of the Association of Bridge and Building Superintendents for the seven years of its existence, in concise and convenient form, much superior to that in which the reports originally appeared. The work of this organization is unique, and it is of great value to departments other than those in direct charge of the bridges and buildings. The publications of the association have been in limited editions, merely enough copies being printed to supply the members, and the compilation of the whole work of the organization renders it available for general use among trackmen and others who have to do with the subjects discussed. Mr. Berg has done a great deal of work in preparing the matter and it has been well done. It is indexed and provided with a table of contents. The desire to place the book in the hands of men of comparatively small means necessitated sacrificing something to price and for this reason we shall not criticise the paper and cuts, which would doubtless be better if low price was not an important object.

"Traité de la Construction, de la Conduite et de l'Entretien des Voitures Automobiles." Publié sous la Direction de Ch. Vigreux, Ingénieur Civil, Répétiteur à l'Ecole Centrale des Arts et Manufactures. Par Ch. Milandre et R. P. Bouquet. Premier Volume, "Construction." Paris: E. Bernard et Cie., 53 Quai des Grands-Augustins. 4 francs. 1898. 300 pp., 156 figures.

This is the first of four illustrated volumes on the automobile carriage written in French and to be followed by treatment of steam, petroleum and electric carriages. The present volume presents the elements of construction of these carriages and illustrations cover the early work in this field as well as the details of present practice. The opening chapter is historical and the second presents general consideration, followed by chapters on resistance to traction, construction of wheels, brakes, transmission devices and the details of construction of other parts. The book is well arranged and will be valuable to those who are pursuing this subject, which is now in an interesting stage of development.

"Workingmen's Insurance," by William F. Willoughby, United States Department of Labor. Vol. XIV., in Crowell's Library of Economics and Politics. Published by Thomas Y. Crowell & Co., 46 East Fourteenth street, New York. 12mo; cloth, $1.75.

This important work is devoted to the most painstaking and exhaustive examination of the problem of the insurance of workingmen against acidents, sickness and old age, that has yet been made. The author, Mr. William F. Willoughby, of the United States Department of Labor, has had exceptional opportunities for making this study. As an expert of that

department he has been repeatedly sent abroad on official investigations, during which he represented the United States Government at the International Congress, in relation to accidents to labor and social insurance, and other international labor assemblies. He was in this way brought into direct relations with officials connected with foreign insurance institutions, and was thus enabled to base his work entirely upon primary sources of information and personal investigation. His study includes an examination of the various systems of employes' relief departments organized by railway corporations in this country and Europe or by other large employers of labor, the insurance work of labor organizations in the United States and of friendly and other mutual aid societies. In carrying out this work, the author has aimed to make it one that not only would be of interest to students of social conditions, but would be of real value and assistance to those practically concerned with the management of insurance and relief institutions. The ways in which the present efforts of railway companies and labor organizations are defective, and the manner in which they should be improved, are clearly brought out. The book, therefore, appeals especially to the large number of officials connected with these bodies.

"Machinists and Engineers' Pocket Manual"—Laird & Lee, of Chicago, have just isued in their admirable collection of technical reference books a "Machinists and Engineers' Pocket Manual," edited by D. B. Dixon, a complete and compact work for reference by machinists and engineers. It includes a compilation of rules and solved problems pertaining to steam engines, steam boilers, steam pumps, etc., based on plain arithmetic, and free from algebraic difficulties, together with necessary tables and data of highly practical value in the machine shop, mechanical drawing room and steam power plant. It embraces a dictionary of terms used in steam engineering and electricity, the construction and operation of dynamos and motors, artificial refrigeration and ice making, treatise on the steam engine indicator, gearing, shafting, lathe screw cutting, etc., etc. It is an illustrated volume of 371 pages, printed on excellent paper and bound in leather, in pocket form, edited by a practical engineer for practical artisans and mechanics. Leather, with rubber band, and pocket; $1.

"Monthly Summary of Finance and Commerce of the United States," April, 1898. Corrected to June 1, 1898. With two diagrams prepared in the Bureau of Statistics, Treasury Department. Mr. O. P. Austin, Chief of Bureau. Government Printing Office, Washington, 1898.

This summary is too well known to require extended notice at our hands. Its prompt appearance—copy received June 4, 1898—will be appreciated by those who have occasion to make use of the valuable tables.

"A General Freight and Passenger Post, a Practical Solution of the Railroad Problem," by James Lewis Coles. Third edition. G. P. Putnam's Sons, 27 West Twenty-third street, New York. 1898. Cloth, 312 pp., $1.25.

This book suggests a system of operation of railroads similar to that of postal service, the rates being uniform regardless of the distance, and the application of this principle to be under control of the postoffice.

"Picturesque University of Wisconsin." Edited by W. H. Hibbs. Thirty-two pages, 11 by 15 inches; many illustrations.

This is a handsome, well illustrated and well printed folio of engravings from the "Daily Cardinal," the local students' publication at the University of Wisconsin. The location of the University Buildings is beautiful and this publication presents an excellent idea of the facilities for study, investigation and recreation. The equipment for engineering work is especially good.

"The Cost of Generation and Distribution of Electrical Energy," by Robert Hammond. Except "Journal of the Proceedings of the Institution of Electrical Engineers." Part 134, Vol. XXVII. Paper read March 24, 1898.

This is one of the most complete and exhaustive papers upon the subject of cost of power that we have seen. It compares the cost in detail, of the generation and distribution in a large number of cities and covers several years. The paper fills a pamphlet of 152 pages, and by means of tables and diagrams the author shows reasons for prophesying a very great reduction in the cost of electric power per unit.

Eighteenth Annual Report of the United States Geological Survey to the Secretary of the Interior, 1896-97. Charles D. Walcott, Director. In five parts, Part V. in two volumes. Mineral resources of the United States, 1896. Metallic products and coal. The same continued. Mineral resources, non-metallic products, except coal. David F. Day, Geologist, Chief of Division. Washington, Government Printing Office, 1897.

Commerce and Navigation of the United States for the Year Ending June 30, 1897. Vol. II, prepared in the Bureau of Statistics. Worthington C. Ford, Chief of Bureau. Washington, Government Printing Office, 1898.

"The Automotor and Horseless Vehicle Journal, a Record and Review of Applied Automatic Locomotion," is a monthly illustrated journal, devoted to automobile carriages and allied subjects. It is published at 62 St. Martin's Lane, Charing Cross, London. Price, 6d.

"The Foreign Commerce and Navigation of the United States for the Year Ending June 30, 1897." Vol. I, Treasury Department, Bureau of Statistics, Worthington C. Ford, Chief of Bureau. Government Printing Office.

"The Rose Technic," published at Terre Haute, Ind., is one of the brightest and best edited of the college magazines that we receive among our exchanges. The alumni show interest in it by contributing articles upon subjects connected with their practice.

"Annual Report of the State Board of Arbitration of Massachusetts," for the year ending December 31, 1897.

"Bulletin of the Engineering Department University of Vermont," State Agricultural College, Burlington, Vt., 1898.

"Railroad Commissioners' Report, Massachsetts," returns of 1897. Boston, January, 1898.

"Annual Report of the City Engineer of the City of Providence for the Year 1897." Otis F. Clapp, City Engineer.

"Eleventh Annual Report of the Interstate Commerce Commission, 1897." Washington, Government Printing Office.

"Report of the War Department, 1897, Chief of Engineers." Six volumes with plates and tables.

Register of the Lehigh University, South Bethlehem, Pa. 1897-1898.

PNEUMATIC TOOLS.—The rapidity of the progress which pneumatic tools have made in application to various kinds of work previously always done by hand is best appreciated by contrasting the handsome morocco bound catalogue of the Chicago Pneumatic Tool Company, now before us, with the modest representation of the Boyer pneumatic hammer with which this firm entered the field less than three years ago. Probably no business of this kind ever has had a more rapid growth, the explanation for which is that people want and must have these tools because of the saving effected by them in labor and quality of work. They have revolutionized railroad repair shop work as regards chipping, reaming, boiler flue beading and similar work, and the same statement applies with equal force to shipbuilding, an air compressor now being a necessity in every shop. These tools are making as good headway in Europe as in this country. The catalogue states that they are in use on 245 railroads in the United States and Canada, and on every prominent railroad in Europe, as well as in over 2,000 boiler shops and shipyards. Anything that stirs conservative Europe to this extent must be first class in every respect.

The tools illustrated in the catalogue are as follows: "Chicago" and Boyer breast drill, pneumatic riveter, pneumatic casting cleaner, Boyer speed recorder, piston air drill, flue roller, expander and cutter, flue welder and reducer, Manning sandpapering machine, air hoist and compressor and Chicago rotary drill.

The hammer when used for beading locomotive boiler flues will bead 250 in 100 minutes. Five sizes of hammers are furnished—Nos. 0, 1, 2, 3 and 4. No. 0 is used in connection with a "holder on" in riveting; No. 1 is for light riveting, chipping and calking; No. 2 is used for general purposes, as chipping and calking; No. 3 is for flue beading and general calking, and No. 4 for light chipping and calking. The hammer will do the work of four men when used for beading flues, calking or chipping boilers, or cutting off staybolts.

The catalogue publishes a number of letters received from

high officers in prominent shipbuilding firms, and among them is one from Mr. Sommers N. Smith, General Superintendent of the Newport News Shipbuilding & Dry Dock Company, in which he says of the hammers and drills: "They have been tested upon drilling, chipping, reaming and calking upon steel castings, protective deck plates, angles, hull plating, and armor plates; also, on boiler and machine work, and they have more than fulfilled our expectations." Similar letters from other firms are shown, among them from the Bigelow Company, New Haven; John Mohr & Sons, Chicago; the Globe Iron Works Company, Cleveland, and the Chicago Shipbuilding Company. Mr. Henry W. Cramp, Vice-President of the William Cramp & Sons Ship & Engine Building Company, says of these tools: "They have given entire satisfaction both as to efficiency and endurance and as to celerity of operation." Over 100 of these pneumatic tools have been supplied to this firm of shipbuilders.

The use of pneumatic hammers for riveting is new, and the results are surprising to those who see the work for the first time. The No. 1 hammer will drive rivets up to ⅝-inch diameter, and the No. 0 takes rivets up to ⅜-inch diameter.

The company has added a lot of new appliances to its list of productions during the past year, and we are told that there is great difficulty to keep the supply up to the demand. The company is sparing no expense or effort to improve its product, which keeps them far ahead of all competitors. Nearly all of the tools illustrated and described on pages 238 and 239 of our July issue, showing the exhibit at the recent convention at Saratoga, were sold on the spot. The flue cutter attracted more attention than any other exhibit at the convention.

The catalogue, with 32 fine engravings made from wash drawings, is a creditable piece of work. It is bound in leather, and is interesting as well as attractive. We shall give our readers complete descriptions of many of these interesting tools. The wonderful success of the company in this country and abroad is due to the energy, perseverance and business capacity of Mr. John W. Duntley, President.

The "Pall Mall Magazine" for July has an interesting article by Mr. Angus Sinclair, editor of "Locomotive Engineering," on the "Evolution of Comfort in Railway Traveling in America." The history and development of sleeping and parlor cars, the comforts of travel in this country, car lighting—in which the Pintsch system is stated to be the successful system of lighting in general use—and the development of dining cars, are all treated in a pleasant way. Of the development of car lighting he said:

"A great variety of oil lamps were tried, and some of them threw a very good light upon the roof, but they were a delusion to the person who tried to read by them. The line of progress was toward gas, and a great many systems of gas lighting were tried. None were satisfactory until the Pintsch gas was introduced. That system is now general in the United States, and is satisfactory. The cars are very well lighted, and the jets of gas run from 200 to 350 candle-power for each car. Electric lighting has been introduced on some railroads, but it does not increase in popularity."

The Phosphor-Bronze Smelting Co., Limited, of 2200 Washington avenue, Philadelphia, have just issued "Price List No. 13," dated June 1st, 1898. The list gives prices for roll and sheet phosphor-bronze, for the metal in wire coils, in telegraph and telephone wire, rods, cast bolts, nuts and washers, wire ropes, cords and rigging ropes, tiller ropes, nails, wood screws, sash chains, gunpowder mill tools and a variety of other phosphor-bronze products. Those having occasion to use this material in these forms and those using bearing metals, should procure a copy of this list. This firm manufacturers the "Elephant Brand" phosphor-bronze and other alloys.

The Westinghouse Electric & Manufacturing Co. have printed a small eight-page pamphlet entitled, "Protection, Not in Fancy, but in Fact," calling the attention of street railway and central station managers to their line of lightning arresters and choke coils. Among them are the Wurts lightning arresters for alternating currents; non-arcing metal, double pole, station arresters; high potential arresters for 15,000 volt currents used as transmission circuits; those for direct current circuits; for railway service and multiple spark gap choke coils for street railway service.

"Proceedings of the Fifth Annual Convention of the Association of Railroad Air-Brake Men." Held at Baltimore April, 1898. The proceedings of this wide-awake and exceedingly useful organization contain reports and discussions of the convention, including subjects having to do with the construction, operation and maintenance of the air brake upon trains. The pamphlet is a valuable one and the information given is from the practical men who are directly concerned with the apparatus. As an appendix, Mr. R. A. Parke's paper on "The Effect of Brake Beam Hanging Upon Brake Efficiency" is added. Also a list of members and the constitution. The secretary is Mr. P. M. Kilroy, Pine Bluff, Ark.

"Graphite as a Lubricant." The Joseph Dixon Crucible Co. of Jersey City, N. J., have sent us a copy of the 1898 edition of their 34-page pamphlet, having a new cover and four pages of new matter. The use of graphite for lubricating gas engines is worthy of note, and we have already called attention to its employment for this purpose on the Pennsylvania Railroad. The pamphlet illustrates a hand oil pump for introducing graphite or oil into engine cylinders, putting it just where it is needed. The experience of engineers with graphite, which this pamphlet presents, is worthy of careful attention, and we understand that the pamphlet as well as samples of graphite will be sent to any one interested in better lubrication.

The Chicago Pneumatic Tool Company has issued a handsome special catalogue in pamphlet form, illustrating the exhibit of pneumatic tools at the Saratoga conventions of the Master Car Builders and Master Mechanics' associations. The tools shown in this pamphlet are those described on page 238 of our July issue, and examination of the engravings will give an excellent idea of the wide scope of this convenient, labor-saving machinery. The pamphlet, like all of the publications of this company, is in good taste, and the work is handsomely executed throughout.

Q. & C. Catalogue. A supplement to Catalogue C and D has been received from the Q & C Company, 700 Western Union Building, Chicago.

It illustrates and describes the Stanwood steel car step, self feeding rail drills, compound lever jacks, M. C. B. standard steel brake shoe keys, portable rail saws and power cold saws for frogs, crossings and switch work.

"Air Compressors, 1898." Catalogue No. 32. The Ingersoll-Sergeant Drill Co., 26 Cortlandt street, New York. There is little to be said about the product of this firm, its compressors are so well known to our readers. The present catalogue brings them up to date and presents a great deal of valuable information not published before. It describes and illustrates the air compressing product of these builders and is a complete and valuable compendium of their standard machinery. The paper, printing and engraving are excellent.

"Summer Resort Train Service," New York Central & Hudson River Railroad, is a four-page illustrated pamphlet containing statements of the train service to the Thousand Islands, Adirondack Mountains, Saratoga, Lake George, Lake Champlain, Niagara Falls, Richfield Springs, White Mountains and the Maine sea coast summer resorts. Four enticing half-tone engravings speak volumes for the enjoyment to be obtained at these famous summering places. The pamphlet was prepared by Mr. George H. Daniels, General Passenger Agent.

"New England Lakes" is the title of a pamphlet just issued by the passenger department of the Boston & Maine Railroad. It has but a single page of text accompanying a fascinating and alluring series of half-tone views of what are very properly called "Aqueous Brilliants of New England's Crown."

A Water Purifying Plant.

BY HOWARD STILLMAN.

[This paper was read at the December, 1897, meeting of the American Society of Mechanical Engineers, and we reprint it, in abstract, by request, as it has not appeared except in the proceedings of the society.]

About a year ago the Southern Pacific Railroad Company established at Port Los Angeles, Cal., a plant or adjunct to the pumping station for the purpose of purifying the water supply at that point of the large amount of scaling matter it contained.

The chemical principles involved are based on the well-known Clark or Porter-Clark process.

The method which we are to discuss is intended to do away with an elaborate system of works, and to furnish a continuous supply of purified water of constant quality without the use of agitators to assist chemical action, or the necessity for labor other than that in usual attendance at a water station.

The water at Port Los Angeles required a double treatment on account of the bi-carbonate of lime contained, together with a large amount of the sulphates of lime and magnesia.

ical tanks is kept at a desired pressure, just overbalancing the hydraulic pressure in the water main, and allowing the solution to flow through the ¼-inch feed-pipe when the cocks *f* are open. These cocks are always operated wide open to prevent possible clogging up of the pipe by a casual obstruction, and the air pressure is allowed entirely to control the flow of solution to mingle with the water flowing through the circulating tanks to the reservoir. The pressure-regulating valves are controlled in the usual manner by wrench and screw at bottom, so that the operator can occasionally adjust the feed of solution. Each chemical tank is about four feet high, and provided with a long-sight feed glass so that the contents can always be noted. They are gauged to feed out 11 inches per hour, and when pressures are adjusted do not ordinarily vary. Occasional attention to the pressure valve during pumping hours, such as an engineer gives his sight-feed lubricators to steam engine or pump, is sufficient, inasmuch as the hydraulic pressure during pumping hours does not vary more than the head varies in a gravity supply. It has been found that the air pressure on the chemical tanks is about an atmosphere less than hydraulic pressure in the main, so that, at would be expected, the pneumatic action is to hold back the solution from flowing out too fast. As referred to above, this feed could have been regulated from the cock *e*, or the pipe made smaller, but it was desired that at no time should the operation "hang fire" by clogging of a small opening. When the pumping ceases the cocks *e* in feed-pipes are immediately closed,

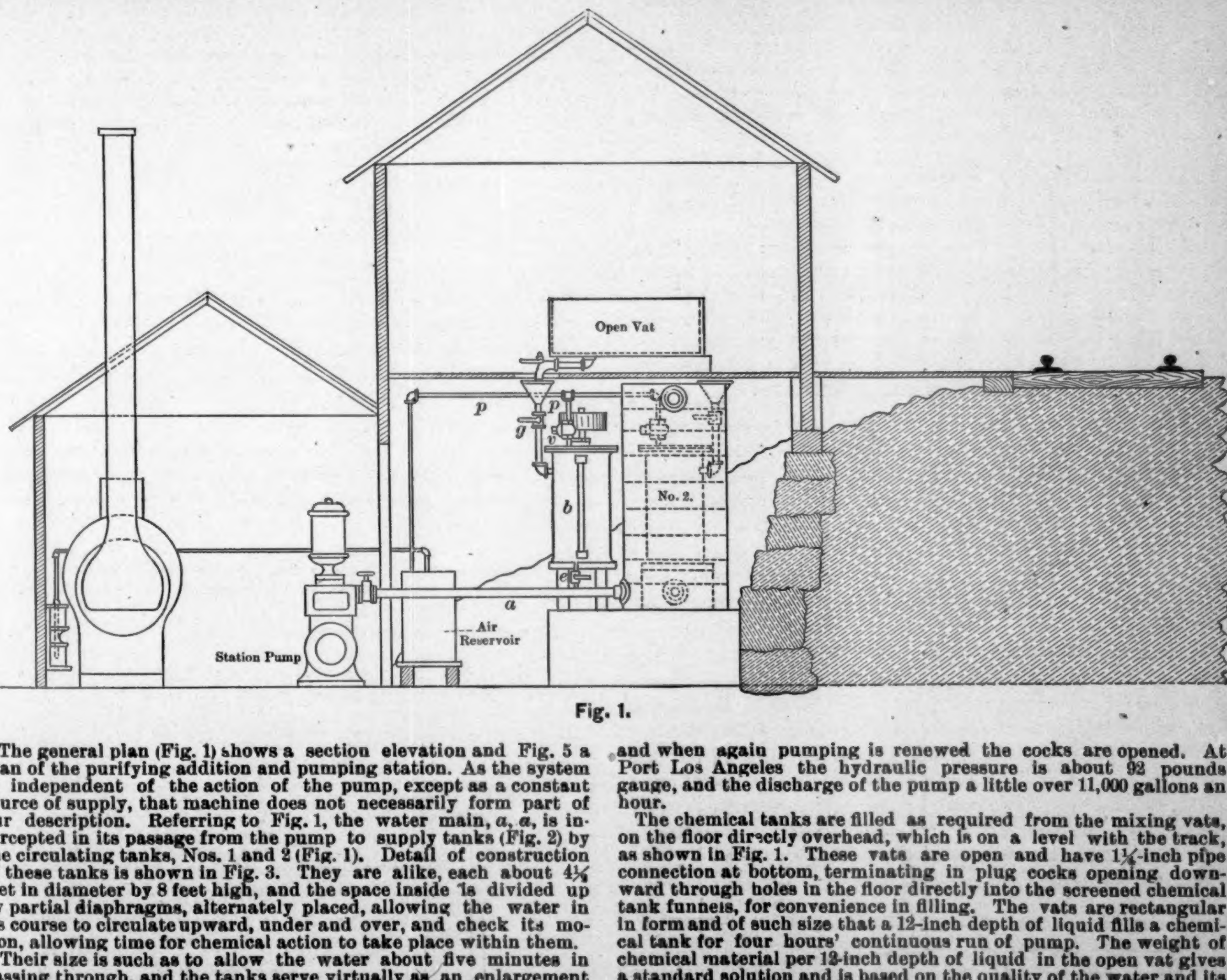


Fig. 1.

The general plan (Fig. 1) shows a section elevation and Fig. 5 a plan of the purifying addition and pumping station. As the system is independent of the action of the pump, except as a constant source of supply, that machine does not necessarily form part of our description. Referring to Fig. 1, the water main, *a*, *a*, is intercepted in its passage from the pump to supply tanks (Fig. 2) by the circulating tanks, Nos. 1 and 2 (Fig. 1). Detail of construction of these tanks is shown in Fig. 3. They are alike, each about 4½ feet in diameter by 8 feet high, and the space inside is divided up by partial diaphragms, alternately placed, allowing the water in its course to circulate upward, under and over, and check its motion, allowing time for chemical action to take place within them.

Their size is such as to allow the water about five minutes in passing through, and the tanks serve virtually as an enlargement of the water main at that point; the arrangement of the diaphragm or baffle plates is not essential to the process, and the circulating tanks are not intended to deposit or dispose of sediment. The water main enters tank No. 1 at the bottom and discharges at the top, thence to bottom of No. 2, again discharging at top, and on to the supply and settling tank (Fig. 2).

Just before entering each of these circulating tanks the water main is tapped by a ¼-inch pipe, conveying in a steady stream, when in operation, a solution of desired chemical reagent from the chemical tanks at *b*, *c*. These chemical tanks are shown in detail at Fig. 4, and the ¼-inch feed-pipes leading from them, *e*, *e*, are controlled by the plug cocks *f*, *f*. These smaller tanks are also of like dimension, and hold 100 gallons when charged with solution, which suffices for four hours' continuous operation of the pump, or a supply of about 44,000 gallons of water. As shown in Fig. 4, the tanks are air-tight when all cocks are closed, and are filled through the 1¼-inch pipe and screened funnel when the cock *g* is open. The top is tapped by a ¼-inch pipe leading from an air reservoir supplied with compressed air from an 8-inch Westinghouse pump. Just before entering the tanks the small air-pipe *p* is intercepted by a pressure-regulating valve, *v*, whereby the air pressure within the chem-

and when again pumping is renewed the cocks are opened. At Port Los Angeles the hydraulic pressure is about 92 pounds gauge, and the discharge of the pump a little over 11,000 gallons an hour.

The chemical tanks are filled as required from the mixing vats, on the floor directly overhead, which is on a level with the track, as shown in Fig. 1. These vats are open and have 1¼-inch pipe connection at bottom, terminating in plug cocks opening downward through holes in the floor directly into the screened chemical tank funnels, for convenience in filling. The vats are rectangular in form and of such size that a 12-inch depth of liquid fills a chemical tank for four hours' continuous run of pump. The weight of chemical material per 12-inch depth of liquid in the open vat gives a standard solution and is based on the quality of the water and its hourly rate of flow through the main to the reservoir, which data give the key to the situation; as, for instance, supposing analysis and tests of the water show that it will require $1\frac{64}{100}$ pounds of unslacked lime to absorb the carbonic acid in 1,000 gallons. The flow through the main being 11,000 gallons per hour and the charge to last four hours, then we have 4 by 11 by $1\frac{64}{100}$, or 72 pounds of lime to be slacked with water to a depth of 12 inches (100 gallons) in the mixing vat. When slacked and mixed the liquid is a cream of lime, which is run off into the chemical tank when desired, as before stated.

It requires about five minutes' time to refill the chemical tanks and recharge with air, at which time the water supply or pump is stopped.

The tank charged with cream of lime is provided with an upright revolving shaft carrying paddles, as shown in Fig. 4, and works through a stuffing box in the top by means of a small air motor. The paddles revolve slowly when the tank is feeding into the main, and their purpose serves to stir up the milk of lime to prevent it settling out, and thus deliver a constant amount of lime to the water being treated.

We have just considered the operation of introducing quick-

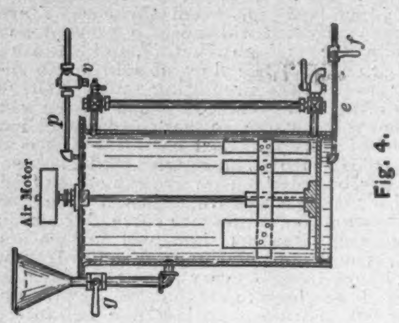


Fig. 4.

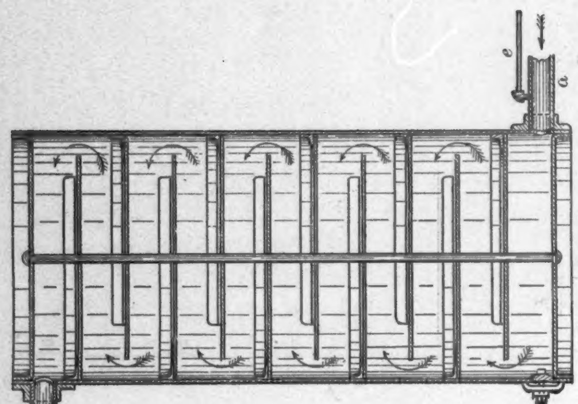
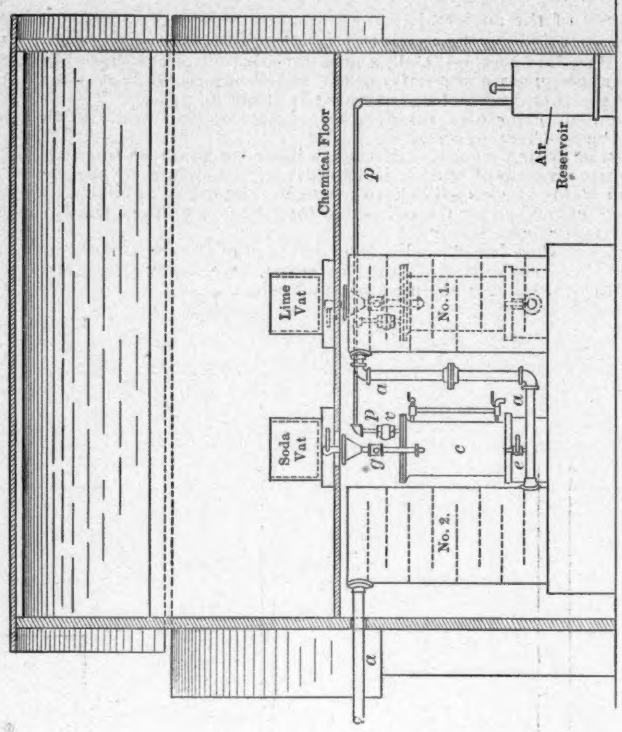


Fig. 3.



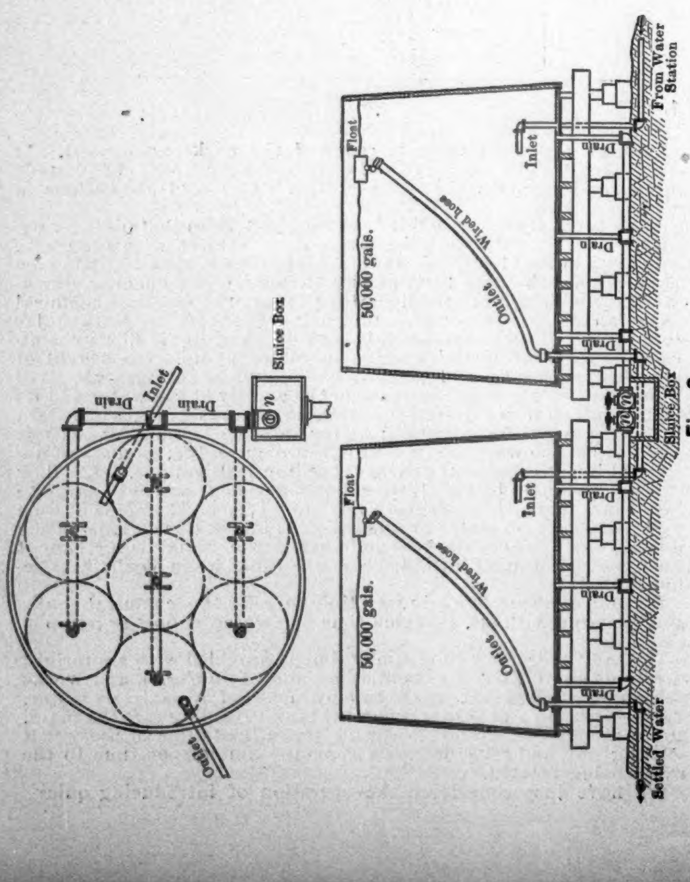


Fig. 2.

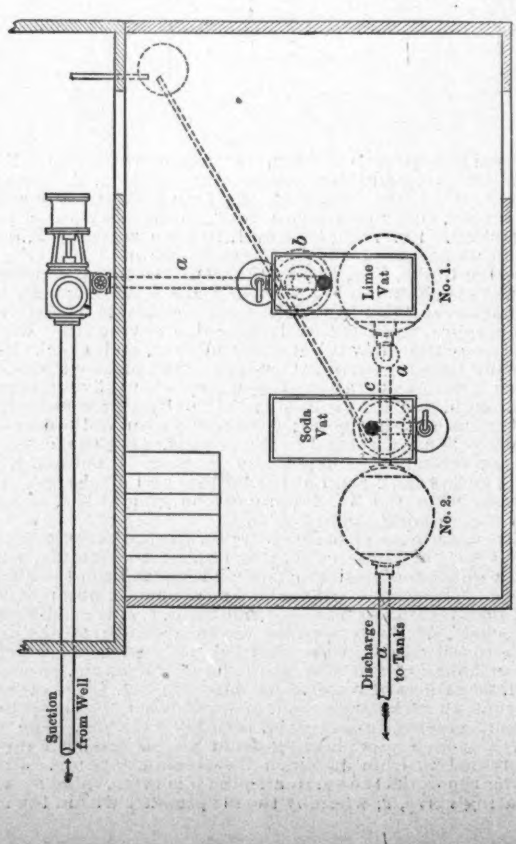


Fig. 5.

A RAILROAD WATER PURIFYING PLANT.

lime into the water in proper proportion to effect absorption of carbonic acid and consequent precipitation of carbonates in solution. The roily water now passes on through circulating tank No. 1, and this part of the desired reaction occurs more or less completely. As referred to before, the water supply at Port Los Angeles contains, besides the carbonates in solution, a large amount of sulphates, lime, and magnesia.

These salts, not being converted by quick-lime, required a second reaction. The use of the necessary amount of caustic soda to effect this would have been expensive, besides other objections to its use. Soda ash was good and cheap, but would react with the lime, directly, to form carbonate of lime if introduced with it; hence its use necessitated the second chemical tank, with its mixing vat, which is operated by the same method and simultaneously with the lime tank.

The soda tank is like Fig. 4, except that it requires no stirring device, as the solution is some distance from saturation and does not settle out. The weight of soda ash put into the soda mixing vat is dependent on same data as before, the amount required to convert the sulphates being $2\frac{3}{10}$ pounds (per 1,000 gallons), we have 4 by 11 by $2\frac{3}{10}$, or 96 pounds to be dissolved in water to 12 inches depth in the mixing vat.

The lime is prepared by placing the stated weight of a good commercial article (fresh burned) preferred in the vat and letting in from an adjacent hydrant enough water to slack, after which more water is added to the required 12-inch depth.

The soda is prepared in its vat in the same manner, except that it is simply a matter of solution which is quite strong yet not saturated, hence no separation or crystallization of sal soda occurs in the chemical tank.

As the water in the main receives its second injection from the soda tank, it passes on through the circulating tank No. 2, where the carbonate soda effects its reaction more or less completely, and thence on to the storage and settling tanks, which are at least large enough to contain 24 hours' supply. The treated water is milky with precipitated carbonates, and discharges through the inlet pipe about 4 feet from the tank bottom. The outlet to this tank is a piece of 4-inch wired hose, the open end of which attaches to a float on the surface, as shown in Fig. 2. By this means the clearest water in this tank passes on to the second similar tank by the same method. Clean water is always obtained from the surface outlet of the second tank.

The chalk deposit is considerable at the bottom of the settling tanks and has to be drawn off occasionally, which is effected by the "spider-drain" system shown in Fig. 2, which consists in tapping the tank bottom with seven 4-inch drain pipes. The location of these drains is shown in the plan of one of the tanks (Fig. 2), the drainage areas being indicated by the tangent dotted circles.

The vertical 4-inch drain pipes open into larger horizontal pipes, and these into a 9-inch pipe at right angles, terminating in the sludge valve shown at *n*, Fig. 2. This valve discharges downward into the sluice box, and when opened the tank bottom is drained from seven equidistant openings, which keeps the chalk deposit down near the tank bottom and prevents the "angle of slope" which the deposit would assume with but a single central discharge, whereby the deposit would accumulate up along the sides of the tank to interfere with clear settling, and would also require an occasional scraping or shoveling out. Each of the tanks is provided, independently, with this spider-drain arrangement, though both sludge valves discharge into the same sluicebox.

The following analyses are shown of the Port Los Angeles water supply in tabulated form "before" and "after" treatment. The analysis "before" is one of several which were made at intervals during a year previous to putting in the treating system. None of these analyses varied materially with the season. The analysis "after" was made about two months after the system went into operation, and is also one of several made during the past year, without showing material variation in the treated supply.

SOURCE OF SUPPLY, WELL IN BED OF SANTA MONICA CANON, ABOUT 100 YARDS FROM PACIFIC OCEAN BEACH.

Date of Analysis.	Before March, 1896.	After December, 1896.
Treatment per 1,000 Gallons.		Lime, $1\frac{64}{100}$ pounds. Soda Ash, $2\frac{3}{10}$ pounds.
Contained in the water in solution in grains per U. S. gallon :		
Carbonate-lime	14.29	.69
Sulphate lime	5.07	.29
Carbonate magnesia	1.22	7.15
Sulphate magnesia	17.15	1.63
Silica	1.34	.11
Alumina	.17	.17
Sulphate soda	3 56	27.92
Chloride soda	8.75	5.71
Total	51.55	43.67
Incrustating matter	39.24	10.04
Non-incrustating matter	12.31	33.63

Cost per 1,000 gallons to treat, 4 cents.

While the treated water is not shown to be "purified" in the proper sense of the term, yet it is converted to a fairly good water for boiler use. Previous to treatment the water formed a large amount of very hard scale, with considerable corrosion.

A switch engine with clean boiler was put to work on the wharf at Port Los Angeles, using only treated water, not long after the plant was put in operation, and observations made at intervals on the action of the water. No scale forms from its use, but a small deposit of magnesia sludge, having no tendency to form scale, has at times been observed. Otherwise the treatment has greatly improved the quality of the supply.

The "standardizing" of the process for treatment of such waters as may thereby be benefited has been based on the following principals :

All tanks, vats, etc., to be made in sets of three sizes, the smallest being adapted to water stations having a delivery of 4,000 gallons per hour or less, the second 4,000 to 8,000 gallons, and the third 8,000 to 12,000 gallons.

Storage and settling capacity for a station to be sufficient for at least 24 hours' supply, unless circumstances allow other arrangement as to settling.

The character (from analysis) and rate of flow of water at a station being known, it remains to substitute such weight of re-agents in a circular of direction, properly posted at the water station, as will supply necessary instruction to a person of ordinary intelligence.

FROG AND GUARD RAIL PROTECTION.

An important bill, which deals with a familiar subject upon which legislation of the same character has heretofore been sought without success, has been introduced in Congress. It provides: "That all persons, companies or corporations owning and operating a railroad or railroads, or operating a railroad owned by another person, persons, company or corporation in the United States, or within the military reservations of the United States or the District of Columbia, shall, and are hereby required, within six months after the passage of this act, to adjust, fill or block or securely guard the frogs, switches and guard rails on their roads (with the exception of guard rails on bridges), in all yards, divisional, and terminal stations, and where trains are made up, as to thoroughly protect and prevent the feet of employees or other persons from being caught therein, with the best approved metallic appliances that are known up to date." The penalty for failure to comply with the provisions of the act is fixed at not less than $500 or more than $2,000 for each offense, and "each unfilled angle shall constitute a separate offense."

A PERMANENT EXPOSITION FOR NEW YORK.

A plan for a permanent exposition in the city of New York has been quietly maturing for some time, the Merchants' Association being apparently the most active influence in connection with it. The idea is to establish the exhibition in specially constructed buildings after the manner of similar institutions in London, Paris and Berlin. With a provision of $20,000,000 to start with, it is expected that the European exhibitions will be surpassed, and there appears to be good reason to expect that this amount may be easily raised when needed. A committee representing various business and manufacturing interests is to be formed to carry the movement forward. The scheme is intended to provide means for extending trade and to facilitate the ordering of American productions without the necessity for spending a great deal of time in traveling about the country. The exhibits will provide for manufactures, from wire nails to locomotives and cars. One of the advocates of the plan, interviewed by a representative of the New York "Commercial," says:

"Foreigners are coming to look to Americans for everything that they need, and it is only just to them that we should make it as convenient as possible for them to secure our products. The venture has already secured such encouragement that there is no doubt whatever of its success. I am satisfied that after the first meeting, to be held in October, the matter will be in such shape that we can immediately open the subscription books, and that the necessary money will be forthcoming in a short time.

"It would be an exhibition in every sense of the word, with no music or ice cream or dancing in the evenings—nothing but business. Of the different buildings to be erected, each would contain a separate line of products. For instance, one with locomotives, passenger and freight cars, air brakes and the thousand and one things pertaining to railroads. The same building could also contain all of the appliances for traction cars and everything else used in the construction of a street car line. Thus, each line of trade will be housed in a separate building."

The legal department of the Lehigh Valley is to be removed to New York from Philadelphia.

The Northern Pacific has begun to restore wages by giving engineers an increase of about 15 per cent.

The Missouri, Kansas & Texas shops at Dennison, Texas, have been reopened. They were shut down about two months ago.

The track of the Flint & Pere Marquette, from Port Huron to Grindstone City, 92 miles, has been changed to standard gauge.

The Pennsylvania, under the revenue law, is put to an expense of about $1,000 per month for check stamps, about 60,000 being used each month.

The New York, New Haven & Hartford application of the third rail electric system will probably be completed to Bristol within a few days.

The "New York Commercial" predicts that within a year the number of roads in the hands of receivers will be as small as it was in the years immediately preceding 1893.

Pullman conductors will stamp all sleeping and parlor car tickets when they take them up, thus relieving ticket agents of all trouble and responsibility in regard to the war tax.

The Pennsylvania is to continue the use of oil for laying dust on ballast, and it is found necessary to make a second application to the portions of the road that were covered last year.

The Big Four has begun the practice of giving all repair work and reballasting of tracks to contractors. It recently awarded a contract for reballasting 100 miles of the St. Louis division.

It is reported from Austin, Texas, that the Gould railway interests are soon to be extended into Mexico, and that a representative has been making a careful inspection of the Monterey & Mexican Gulf with a view to its purchase.

Louisville is to have a new union station, the contract for its construction having already been let by the Louisville & Nashville Railroad to C. A. Moir of Chicago. It is reported that the new station will be the finest in the South.

The Chicago Pneumatic Tool Company, Monadnock Building, Chicago, recently received an unsolicited order for six pneumatic tools from the Japanese Government Railway. This is proof of satisfaction with the tools in Japan which is worthy of mention because of the low price of labor there.

The boiler plant of the Trans-Mississippi Exposition at Omaha, comprising 3,600 horse power, is contained in a floor space of 25x100 feet. There are six Morrin "Climax" boilers, four of which are capable of evaporating 22,500 pounds of water per hour each, and two can evaporate 15,000 pounds each.

The largest private yacht is Mr. W. K. Vanderbilt's Valiant, of 2,184 tons. To the builders, Laird Bros., Birkenhead, England, the Valiant cost considerably over a half million dollars, besides which very large sums were spent on French upholstery and cabinet work. To keep this boat in full commission takes between $100,000 and $125,000 per year.

The Receivers of the Baltimore & Ohio Railroad have purchased 40 miles of 85-lb. 60-foot steel rails and will experiment with them on the Pittsburg division and in the Baltimore tunnel. These rails were originally bought for the Columbia & Maryland Electric Railroad, which was designed to parallel the Baltimore & Ohio Railroad between Baltimore and Washington and to become an important factor in business between those points. The project failed and the material which was purchased has been sold. Those are the first 60-foot rails to be used on the B. & O.

An English friend has sent clippings from Birmingham papers to the "American Machinist" which show that one of the features of the Barnum & Bailey show, now over there, that attracts most attention is not included in the show proper at all, but is the cars that have been built for transportation of the show from place to place. They are fitted with automatic couplings, and these seem to be attracting great attention and also general commendation. English "shareholders" and others are asking why English cars cannot be equipped with them, and are pointing out the advantages that would result from their use, especially in respect of decreased liability for accidents to trainmen.

The Illinois Steel Co., at its South Chicago Works, has rolled two of the largest open-hearth steel boiler plates ever made in this country, each of which will be used as the shell surrounding the fire box of a consolidation locomotive. Each of the finished plates was 124 inches wide, and 220 inches long on one edge, and 237 on the other; the original sheets before the shearing were 128 inches by 360 inches for one, and 130½ inches by 375 inches for the other, while the ingots from which they were rolled had a cross-section of 18 inches by 40 inches. The actual gauge of one plate measured at the four corners was 0.577 inches, 0.577 inches, 0.574 inches, and 0.576 inches, while at the ends near the middle the gauge was 0.640 inches and 0.623 inches.

One of the largest and best equipped power buildings in the United States is the Manufacturers' Building, Providence, R. I. This building has accommodations for upwards of 60 manufacturing concerns, being particularly well equipped with conveniences for the production of jewelry, specialties, etc. The Manufacturers' Building Company have just purchased a 250 K.W., 500 volt Westinghouse Electric & Mfg. Co.'s engine type generator, 100 r.p.m., to be driven by an Armington & Sims Corless engine. This generator will supply power for the operation of motors in the various manufacturing departments of the building. The engineering features of this establishment are under the direction of Lewis & Claflin, consulting engineers, whose wide reputation for engineering installations of the highest order is borne out by their selection in this instance.

The development of electrolytic processes for the production of refined copper has proceeded very rapidly during the past three years, and at the present time a very large proportion of all the refined copper is thus produced. The Westinghouse Electric & Manufacturing Company have installed a very large amount of apparatus for this class of service. One of the principal installations is at the refinery of the Anaconda Copper Company, Anaconda, Montana, where 10 generators of 270 to 300 K. W. capacity have been installed. Another very large installation is that of the Boston & Montana Consolidated Copper & Silver Mining Company, Great Falls, Montana, where two 810 K.W. Westinghouse engine type generators are in service. The latest comer in this field is the Raritan Copper Works of Perth Amboy, New Jersey, who are about to erect the largest copper refinery in the East. They have contracted with the Westinghouse Electric & Manufacturing Company for three 600 K.W., 150 volt, engine type generators, 150 r.p.m., with a 9 section switchboard for electrolytic service and the operation of two 75 K.W., 220 volt, engine type generators, which will be used for lighting and power service. The installation will be the most complete of its kind in the world.

A 16-inch coast defence gun is being constructed for the War Department at the Bethlehem Iron Works, Bethlehem, Pa., says a contemporary. This enormous gun will be placed somewhere in New York harbor, very likely in a turtle-back turret built upon Romer Shoals, which are almost directly in the center of a line drawn between Norton Point, Coney Island, and Sandy Hook light. Mr. J. F. Meigs, under whose direction the gun is being constructed, calculates that the striking energy of the projectile propelled by a 1,000-pound charge of powder will be 60,000 foot tons. This is approximately equal to the shock which would result were a 6,000-ton steamer brought to a sudden stop while running at a speed of sixteen miles per hour. The range of the gun will be over sixteen miles, and should the present plan be carried out New York will eventually be protected by fourteen such cannon. The following comparison made by Lieutenant Cardon of the biggest guns in the world shows the position that it is anticipated the American gun will hold:

	Calibre, in.	Weight of gun, tons.	Length, ft.	Weight of shell, lbs.	Weight of powder charge, lbs.
United States.......	16	126	49.1	2,350	1,000
Germany............	16.5	120	45.9	2,204	903
Italy...............	17	104	40.75	2,000	900
England............	16.25	110.5	43	1,800	960
France............	16.54	74.2	32.5	1,719.6	595.2

EQUIPMENT AND MANUFACTURING NOTES.

The Barney & Smith Co. are building a business car for officers of the Lehigh Valley that is to be unusually handsome and well appointed.

The Northern Pacific is changing its refrigerator cars to the Wickes system, also the Chicago, Milwaukee & St. Paul has built 250 cars on this system in its own shops, and the Grand Trunk is now building 250 of these cars in their own shops.

The Chicago Grain Door was specified for 1,000 cars which the Chicago, Milwaukee & St. Paul Railway is to build at the West Milwaukee shops and for 1,000 cars for the Northern Pacific, to be built by the Michigan Peninsular Car Co. and the Illinois Car & Equipment Co.

The Sargent Company announces the largest month's business in patented brake shoes in the history of the company for June, 1898. They are extremely busy in the steel department and running to the full capacity, with prospects of heavy business throughout the year.

W. D. Sargent, President of the International Brake Shoe Co., has sailed for Europe, to make arrangements for the manufacture of the Diamond "S" shoe brake in several European countries, including Russia. The success of this shoe since its introduction last Fall has been remarkable.

The Carnegie Steel Company is reported to have received the contract for furnishing 4,500 tons of steel for use in the projected track elevation of the Chicago & Northwestern Railroad at Chicago. It will also supply the Western Electric Company with 1,200 tons of steel for building purposes in Chicago.

The sale of the car works owned by the Memphis Car & Foundry Co., at Memphis, Tenn., has been confirmed, the property passing into the hands of C. J. Wagner, who acquired it at a cost of $25,000. Mr. Wagner states that the plant will probably be run by local parties, if the proper arrangements can be made.

The Schenectady Locomotive Works are building the following locomotives: Ten Mastodon compound locomotives and seven 8-wheel passenger locomotives for the Southern Pacific, fifteen 10-wheel freight for the Chicago & Northwestern, twenty-six locomotives for the Nippon Railroad of Japan, twelve consolidation freight locomotives for the Kiushiu Railroad of Japan, and one engine for the Chicago & West Michigan.

The Schoen Pressed Steel Company of Pittsburg is building a 120 by 650-foot addition to its plant in the form of a steel building, which will be fitted with four 60-foot overhead cranes and other tramways for handling material. It will be ready for use in about a month, and will increase the capacity of the works to thirty complete cars per day, aside from the bolster and truck business. The Baltimore & Ohio has just ordered Schoen bolsters for 3,750 cars.

The Brooks Locomotive Works are building: One American type passenger and four consolidation engines for the Chihuahua & Pacific, two locomotives for the Duluth, Missabe, & Northern, one narrow gage, mogul engine for the Tionesta Railroad, two narrow gage, consolidation engines for the American Railroad & Lumber Company, eight engines for the Pecos Valley Railroad and three passenger and two side tank freight engines for the Hankaku Railroad of Japan.

"Simplex" body and truck bolsters have been specified for 500 cars for the Wabash and 268 cars for the Choctaw, Oklahoma & Gulf. The former lot are building by the St. Charles Car Co. and the others by the Mt. Vernon Car Manufacturing Co. These bolsters, in the opinion of one of our best known motive power officers, who is also in charge of cars, as expressed in conversation with a representative of the "American Engineer," are the lightest that can be made for their strength.

There has been a growing demand among belt users for a more convenient form of belt dressing than the paste. The Joseph Dixon Crucible Co., Jersey City, N. J., are now placing on the market a solid belt dressing in round bars, about eight inches long and two inches diameter. It makes a package convenient to the hand and easy to apply even to fast running belts. The company does not claim that the solid dressing is as good a preservative of the life and elasticity of the leather as the Dixon paste, but it is quick to apply and quick to act, and that is what is wanted by the general run of belt users.

A cargo of steel rails for the Trans-Siberian Railroad in Russia was cleared in July from Sparrow's Point, Md. The British steamer "Venus," loaded with 11,230 tons of steel rails, 6,799 bundles of plates and 4,606 boxes of bolts and spikes, has sailed for Vladivostock, making the sixth cargo sent to that port with parts of the order for forty thousand tons given to the Maryland Steel Co. The value of the cargo of the "Venus" is placed at $69,551. The large British steamship "Strathnevis," about due, will also load for Vladivostock, and it is expected this ship will nearly complete the order, although the steamship "Marao," with a capacity for about 10,000 tons, has been reported chartered.

The McCord journal box and lid have been specified on 250 cars for the St. Joseph & Grand Island, for which orders are about to be placed; on 500 cars ordered by the Northern Pacific from the Michigan-Peninsular Car Company; on 35 logging cars for the Brainard & Northern Minnesota, ordered from the Illinois Car & Equipment Company, on 25 cars ordered by the Iowa Central from the St. Charles Car Company ;on 200 cars for the Minneapolis & St. Louis, ordered from the Michigan-Peninsular Car Co.; on 20 cars for the Rio Grande & Eagle Pass, and on 250 cars for the Delaware & Hudson Canal Co., ordered from the Buffalo Car Works, and have been made the standard on the last named road.

It is reported from Chicago, says the New York "Commercial," that a new corporation is to be formed with $20,000,000 capital, and it is to take over all the assets of Pullman's Palace Car Co., which do not directly relate to its regular business of operating sleeping cars or car building. Its securities will be divided among Pullman's stockholders as an extra dividend. They can hold or release these as they see fit. The report further says a prime advantage of the course will be that the Pullman Co., after such division, will be in a better shape to negotiate with the Wagner Palace Car Co. for a consideration on a basis which will be easier to bring a consolidation about. It is not believed that this plan will be carried out before the regular meeting in October. If there is any such consolidation it is believed the Pullman Co. will be absorbed by the Wagner.

The Baltimore & Ohio Railroad has adopted the use of electric fans on sleeping cars, following the example set by the Baltimore & Ohio Southwestern at Cincinnati, Louisville and St. Louis. At Washington and Mt. Royal Station, Baltimore, the Baltimore & Ohio has sleeping cars which lay for several hours awaiting the departure of trains, thus enabling the passengers to retire several hours before the time of departure of the trains. Ordinarily a railway station is about the hottest place that can be found at night in the Summer, and the interior of a sleeping car is still hotter; if such a thing can be. The fans are placed in the cars as soon as they are backed

into the stations, connected by a flexible cable with the electric current, and they run until ten minutes before the train leaves, thus keeping the interior of the car cool and pleasant for those who are sleeping. The cost is very small, as each station is thoroughly equipped with electric appliances.

The Safety Car Heating and Lighting Company, has prepared a handsome, large wall map of the United States, showing in red lines the railroads using Pintsch gas for car lighting. As this lighting system is used by over a hundred different roads, 90 of which are steam railroads, the red lines, particularly in the eastern section of the country, practically cover all of the railroad lines, forming a striking demonstration of the rapidity with which this business has extended. The equipment of Pullman and Wagner cars is not included in these figures. On the map are stars indicating the gas supply station plants, of which there are now 47, which are located at the chief railroad centers of the country. The use of Pintsch gas in the lighthouse service is extending, 106 gas buoys having been put into service by the Government already. These buoys burn continuously, day and night, for six months or more, according to the size of the storage reservoirs, without requiring any attention. The gas in the tanks of the buoys is compressed to about 180 lbs. pressure per sq. in.

Since war operations have begun, the Wells Light Manufacturing Company, 44 and 46 Washington street, New York, have been busy making shipments of their lights to various places to meet the needs for brilliant and efficient illumination at fortifications, for coast line defence and similar work, which they completely fill. This company has also made a large consignment of their lights to Cuba within the past few days, as the Wells Light has proven itself to be one of the very necessary outfits of war. For facilitating unloading troops, equipment and supplies from transports, the building of roads, fortifications and intrenchments good lights are indispensable, and portable outfits which may be set up anywhere are always needed, especially in campaigning. They are also valuable in hospital service and in caring for the wounded and dead on the battlefield, more attention being now paid to lighting than ever before. The adaptability of this form of light to railroad construction and wrecking service is too well understood to require comment, but it may be said that these always ready, portable, self contained lighting outfits, which may be used out of doors in all kinds of weather, and under cover, if necessary, are growing more popular, with good reason.

OUR DIRECTORY

OF OFFICIAL CHANGES IN JULY.

Astoria & Columbia River.—Mr. T. W. Hansell has been appointed Superintendent of Machinery, with headquarters at Astoria, Ore.

Atlantic Coast Line.—Mr. R. E. Smith, who was Superintendent of Motive Power, has been appointed Assistant to the General Manager. Mr. T. H. Symington succeeds Mr. Smith as Superintendent of Motive Power.

Baltimore & Ohio.—Mr. John M. Marstella, Master Mechanic of the shops at Martinburg, W. Va., died in that city June 25, from a stroke of paralysis.

Bangor & Aroostook.—Mr. F. E. Rogers, Assistant Superintendent, has resigned and Mr. W. M. Brown, heretofore Assistant Superintendent at Bangor, Me., has been appointed Superintendent of the entire line.

C., C., C. & St. L.—Mr. George Tozzer has been appointed Purchasing Agent, succeeding the late A. M. Stimson, deceased. He was formerly Assistant Purchasing Agent.

Detroit & Lima Northern.—Mr. Charles N. Haskell has been elected Vice-President.

Detroit, Toledo & Milwaukee.—Mr. H. S. Rearden has been appointed General Superintendent, with headquarters at Toledo, O., to succeed Mr. N. K. Elliott, resigned.

El Paso & Northeastern.—Mr. C. F. Winn, who has been appointed joint Foreman of the Denver & Rio Grande and the Rio Grande Southern at Durango, Colo., has been appointed Master Mechanic of the El Paso & Northeastern at El Paso, Tex.

Erie.—Mr. A. L. Hopkins, President, and Mr. Roswell Eldridge, First Vice-President of the New York, Susquehanna & Western, have retired since July 1, owing to the transfer of the road to the Erie. Mr. F. P. Moore, Second Vice-President and Treasurer, becomes Third Vice-President, and the following officers of the Erie have been elected to corresponding positions on the acquired road: E. B. Thomas, President; G. M. Cummings, First Vice-President; W. F. Merrill, Second Vice-President.

Eastern Railway of Minnesota.—Mr. D. M. Philbin has been appointed Second Vice-President.

Eastern Ohio.—Mr. J. W. Campbell has resigned as General Manager and the office has been abolished and its duties assumed by Mr. W. H. Stevens, General Superintendent.

Flint & Pere Marquette.—Mr. David Edwards, formerly General Manager, died July 18 in Detroit, at the age of 56 years.

Plant System.—Mr. T. S. Tutwiler has been appointed Chief Engineer, with headquarters at Savannah, Ga.

Galveston, Laporte & Houston.—Mr. T. W. House has been elected sole receiver in the place of Mr. M. T. Jones, deceased.

Great Northern.—Mr. N. D. Miller has been appointed Chief Engineer to succeed Mr. J. F. Stevens, resigned.

Grand Trunk.—Mr. William Cotter has been appointed Superintendent of the Western division, with office at Detroit, Mich., to succeed Mr. A. B. Atwater, resigned.

Great Southern & Florida.—Vice-President William C. Shaw has issued a notice that owing to the death of General Superintendent and Purchasing Agent Jeff Lane of Macon, Ga., the duties connected with the now vacant office will be discharged by the Vice-President.

Indiana, Illinois & Iowa.—Mr. T. P. Shonts, who has been General Manager for twelve years, has been elected President to succeed Mr. F. M. Drake, resigned. Mr. George H. Holt has resigned as Vice-President and Mr. Joy Morton has been chosen to succeed him, with office in Chicago.

Illinois Central.—Mr. M. S. Curley has been appointed Master Mechanic of the shops at Water Valley, Miss.

Manistique & Northwestern.—Mr. A. J. Fox of Detroit, Mich., has been chosen President in place of A. Weston, deceased.

Kansas City, St. Joseph & Council Bluffs.—Mr. C. E. Lamb has been appointed Master Mechanic.

Louisville, Evansville & St. Louis.—Mr. Edward D. Seitz has been appointed Purchasing Agent in place of Mr. W. W. Wentz, resigned.

Montana Union.—Mr. Wm. H. Burns, Vice-President and General Manager of the Montana Union, has retired from that position owing to the absorption of the road by the Northern Pacific, and the jurisdiction of the officers of the latter has been extended over the Montana Union.

Minneapolis, St. Paul & Sault Ste. Marie.—Mr. Thomas Green has been appointed Acting Chief Engineer of this road to succeed Mr. W. W. Rich, resigned.

Mobile & Ohio.—Mr. George W. Stevens has been appointed Purchasing Agent, with headquarters at Mobile, Ala. He was formerly Purchasing Agent and Superintendent of Car Service of the Cincinnati, New Orleans & Texas Pacific.

Omaha Bridge & Terminal Co.—Mr. P. J. Nichols has been appointed Superintendent. He was formerly General Superintendent of the Pacific Division of the Union Pacific.

Poughkeepsie & Eastern.—Mr. Joseph J. Slocum has been appointed Receiver.

Puget Sound & Gray's Harbor.—Mr. S. G. Simpson has been chosen President in place of Mr. J. A. Campbell, with headquarters at Seattle, Wash.

Rio Grande, Sierra Madre & Pacific.—Mr. L. P. Atwood has been appointed Chief Engineer.

St. Louis, Avoyelles & Southwestern.—Mr. N. G. Pearsall has been appointed General Manager.

St. Louis Southwestern.—Mr. William Coughlin, Division Superintendent at Pine Bluff, Ark., has been appointed Assistant General Superintendent of that system, with office at Tyler, Tex. He will have immediate charge of transportation and maintenance of way. Mr. S. W. Kenward succeeds Mr. Coughlin as Division Superintendent at Pine Bluff, Ark.

Texas Western.—Mr. Henry Haynes of Brenham, Tex., has been appointed Receiver.

Union Pacific.—Judge William Cornish of St. Paul, Special Master in Chancery of the Union Pacific, has been elected its First Vice-President, vice Oliver W. Mink. He will shortly remove his headquarters to New York. Mr. Peter J. Nichols, General Superintendent of the Union Pacific, has resigned. His position as General Superintendent will not be filled. Mr. R. W. Baxter, now General Agent of the freight and passenger department of the Union Pacific at Portland, Ore., will go to Omaha as General Superintendent.

Velasco Terminal.—E. D. Dorchester, formerly Secretary and Assistant General Manager, has been appointed General Manager. He succeeds the Hon. L. L. Foster, who recently resigned.

West Shore.—Mr. G. E. Hustis has been appointed General Superintendent of this road to succeed Mr. C. W. Bradley, resigned.

ALPHABETICAL INDEX TO ADVERTISERS.